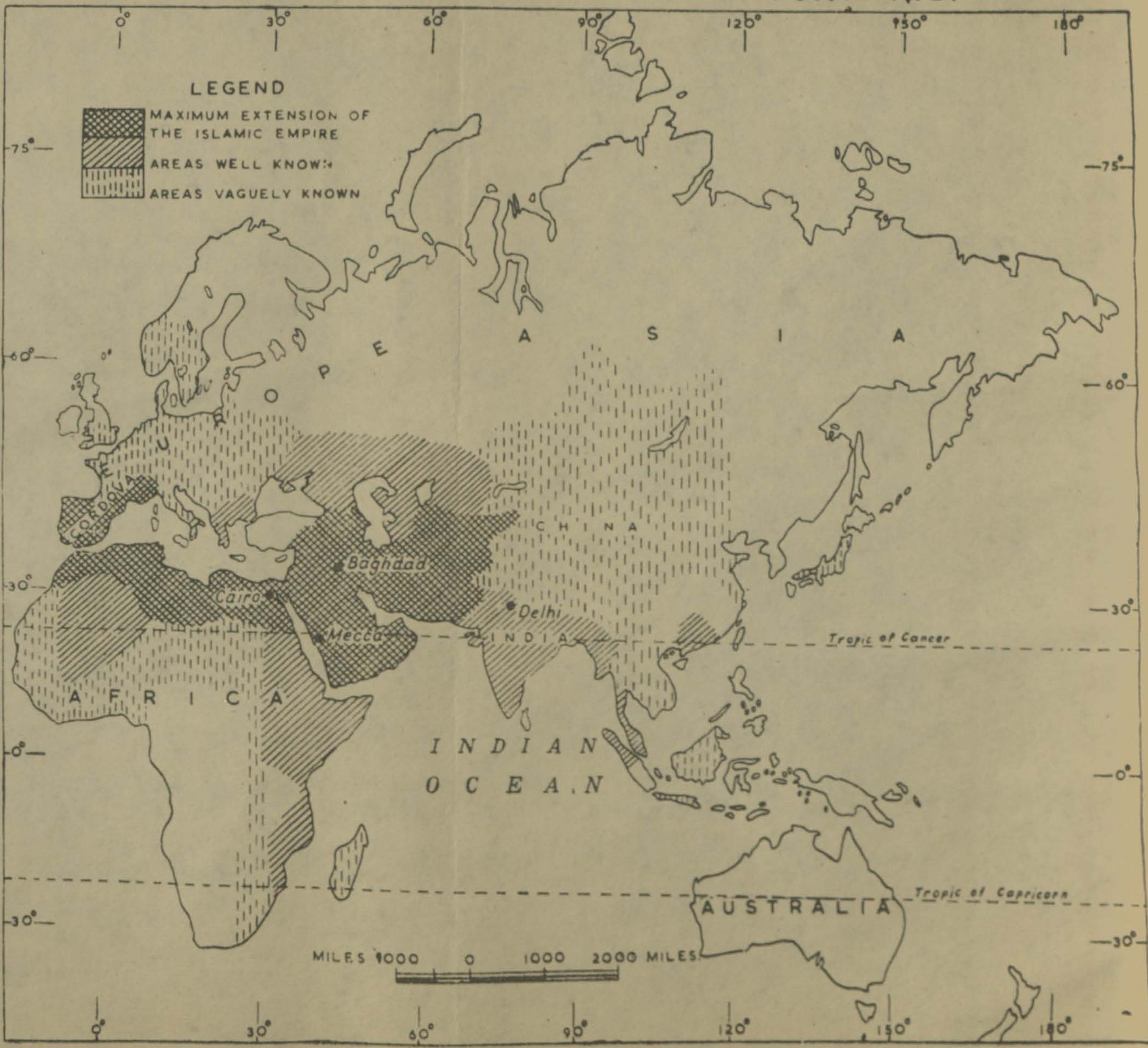
MUSLIM CONTRIBUTIONS TO GEOGRAPHY

By

NAFIS AHMAD

SH. MUHAMMAD ASHRAF
KASHMIRI BAZAR - LAHORE (PAKISTAN)

THE OLD WORLD AS KNOWN TO THE MUSLIMS
FROM THE 8th TO THE 15th CENTURY A.D.



Muslim Contribution to Geography

SH. MUHAMMAD ASHRAF KASHMIRI BAZAR, LAHORE

Frontispiece

MUSLIM
CONTRIBUTION TO
GEOGRAPHY

NAFIS AHMAD, M.A., Ph. D. (LONDON)
Professor of Geography
University of Dacca

o

SH. MUHAMMAD ASHRAF
KASHMIRI BAZAR, LAHORE (Pakistan)

First Edition 1947
Revised and Enlarged Edition 1965
Reprinted 1972

PRINTED AT ASHRAF PRESS, LAHORE AND
PUBLISHED BY SH. MUHAMMAD ASHRAF
KASHMIRI BAZAR, LAHORE (PAKISTAN)

[J433/IX/LXXII/M]

MUSLIM
CONTRIBUTION TO
GEOGRAPHY

By the same Author

BASIS OF PAKISTAN

(Thacker Spink, Calcutta)

AN ECONOMIC GEOGRAPHY OF EAST PAKISTAN

(Oxford University Press, London)

OXFORD SCHOOL ATLAS FOR PAKISTAN (Advisory Editor)

(Oxford University Press, London, reprinted 1969)

To

My Parents

PREFACE
TO THE SECOND EDITION

The revised edition of the book is appearing after seventeen years when it was originally published. In the intervening years no fresh light has been thrown on the subject but an increasing number of students and scholars are becoming aware of the importance of Muslim contributions to Geography in the past.

In the present edition some changes have been made in the scheme of chapters. Particular stress has been laid on the question of the beginnings of Muslim geography and the influence it exerted on the West through several centuries of development. Minor corrections and improvements have also been made in the existing text. It is hoped that the book will continue to draw the attention of students and scholars as in the past.

Dacca
March 15, 1964

NAFIS AHMAD

PREFACE
TO THE FIRST EDITION

While there have been many attempts to recognise and appreciate the extent and value of Muslim contributions to geography, the history of Muslim geographical thought is still to be written. The work of some Western Orientalists of the calibre of Reinaud, De Goeje, Nallino, Sachau, Barthold, Le Strange, Kramers and Minorsky has greatly helped to unfold the many-sided contribution of Muslims to the general advancement of geographical thought and knowledge. But it is increasingly felt that scholars from Islam's cultural *milieu* could help towards a better appreciation and evaluation of this glorious achievement and in the process avoid many a pitfall and overcome some of the cultural, linguistic and socio-religious difficulties which stand in the way of an 'alien' scholar, howsoever painstaking and sympathetic he may be.

This small volume is offered as a modest contribution to studies directed to that end. Much of the ground covered is familiar to students of the subject. But the author's aim has been twofold. First, to illustrate the theme with the help of a large variety of facts and, secondly, to evaluate the output spread over a period of more than six centuries, in a systematic form according to the practice and 'parlance' of modern geography.

The author is fully conscious of many short-

comings and handicaps and shall be grateful to receive helpful suggestions for the improvement of the present work. But I hope that this small book will meet, however partially, the need of a general introduction to the vast subject of the Muslim contribution to geographical thought.

My indebtedness to various writers of established fame, both past and contemporary, through their works in English French, German, Arabic, Persian and Urdu, is immense and as many of them as possible have been mentioned in the footnotes and the bibliography. In addition, I have been fortunate in enjoying the help and encouragement of many friends whose scholarship and advice I have been able to put to good account. In particular, I should mention my dear friend Dr. Syed Akhtar Imam (now Head of the Department of Arabic and Persian, Ceylon University) who suggested a closer study of the Muslim geographical literature in the light of the author's interest in the history of geographical thought, a subject which I had the opportunity of teaching to post-graduate students at the Muslim University, Aligarh, from 1936 to 1940. Among others I am thankful to Dr. Sh. Inayat Ullah, of the Government College, Lahore, for offering many helpful suggestions, Mr. Jalal-ud-Din, of Islamia College, Calcutta, and Miss Indra Sarkar for giving invaluable assistance in translations from Arabic and French and German, respectively; Professor Azizur-Rahman Hashmi and Mr. Ruhul-Quddus, of Islamia College, Calcutta, for assisting in the preparation of the Index, Major R. McConnel, Architect to the Government of Bengal,

for designing the dust-cover and Mr. Abdul Karim Cartographer in the Geological Survey of India, for lettering in the maps. I gratefully acknowledge the permission of the Editorial Boards of the *Islamic Culture*, Hyderabad, and the *Calcutta Geographical Review* for making use of my earlier papers on the subject published in these journals. I must also thank my Publisher, Sh. Muhammad Ashraf for his enterprise in bringing out this book in spite of numerous post-war difficulties.

Lastly, I must add a word of gratitude to my wife who helped at every stage in the writing of the book and later in the preparation of the Index. Her understanding and forbearance, above all, have made the completion of this work possible.

Calcutta, NAFIS AHMAD
Islamia College,
January, 1947.

CONTENTS

MAPS

CHAPTER I

BEGINNINGS OF MUSLIM GEOGRAPHY

INTEREST in geography is as old as recorded human history. This had its roots in ancient folk lores, poetry and travel. The geographical instinct in one form or the other developed early among organized human communities, and the people of the ancient civilizations possessed a variety of geographic knowledge. It is well known to historians that the culture of Greece had been preceded by a continuous and composite culture in Western Asia and Egypt and that this culture in its turn was not the product of the genius of any one people, but was shaped by an ever-increasing human intercourse and was the fructification of a long evolution. Thus Greek geographical ideas also had a basis in the past and in the experience of other peoples. Greek philosophy and poetry formed the tap roots of their geographic knowledge. Similarly, in Arab times, in the evolution of geographic concepts, both Greek ideas and Islamic philosophy and literature were potent factors.

Early Greek contributions to geography were as varied as they were brilliant. Later on, Alexander's campaigns were of the nature of geographical exploration under arms. In the course of time the centre of scientific activity shifted to Alexandria. Science and geography continued to flourish in the Greco-Roman age though under somewhat different cultural atmosphere. In fact, the Greco-Roman culture was subjected

to a severe stress. It faced one of the greatest intellectual conflicts of history, the clash between Greek ideals and the various oriental religions, chiefly Judaism and Christianity.

But before Christianity could triumph, the great geographer Ptolemy (c. 150) had accomplished his work of co-ordinating the sum total of the geographic knowledge up to his times Though a little earlier, Strabo (c. 19) had contributed even more brilliantly in terms of geographic analysis. He also indicated the extent of the knowledge of the Romans about the land and people of Arabia. Describing Gallus' expedition in 25 B.C. to Haura on the Red Sea coast to the borders of Haḍramaut, Strabo says that the Emperor Augustus was also influenced by reports of the wealth of the Arabs and their trading activity in spices, aromatics and precious stones, and he desired either to befriend or subdue such opulent people.[1]

The commencement of the Middle Ages is important in the history of science in general and geography in particular. A general retrogression is witnessed and gradually the so called "Dark Age" of geography set in. It is common to begin the Middle Ages from Constantine, but paganism was tolerated almost until the division of the Empire in 395. But the tradition of pagan literature and science continued much longer, at least until Justinian closed the school of Athens. The triumph of Christianity led its adherents to consider scientific research not only a useless occupation

1. Baker: *A History of Geographical Discovery and Exploration, op. cit.*, p. 26.

but pernicious to religion. Thus the deterioration of science begun by Roman Utilitarianism was further harmed by Christian piety. The Fathers of the Church were as violently anti-Science as they were anti-feminist and certainly in the case of geography, they were believers in curious extravagances and monstrosities. Alexandria had lost its noble place as home of scientific activity and Egypt for the Christians became a land of new wonders as the first home of hermits or desert men or monks; some visitors had no interest in anything else and dismissed the pyramids as mere 'Granaries' of the Kings.[1]

A sailor turned monk took a hand at geographical writing and produced the most cranky of books, the famous Christian Topography in 547. The main purpose of this erudition was to disprove the pagan notion that the earth is a globe. Cosmas hailed from Alexandria and in his younger days had traded in the Red Sea and beyond. Cosmas' earth was flat, rectangular and oblong, twice as long from east to west as from north to south and was surrounded by ocean. A high mountain rose in the north behind which the tiny sun played hide and seek to bring forth days and nights. Beazley rightly called Cosmas' work a 'Systematic nonsense'. Saint Ambrose saw no profit in investigations about the earth. Science, geography, knowledge and all such pursuits were dubbed as magic art. To the pious Christian the maxim of life ran thus, 'Let God be true and every man a liar.' The end of the world was freely predicted in 1000 A.D. and the spherical

1. Thomson : *History of Ancient Geography*, p. 360.

shape of the earth and the existence of antipodes were favourite subjects of ridicule.

Thus the geography of the early centuries of the Christian era is a fascinating mixture. Perhaps, it seldom represented the full amount of contemporary knowledge but was largely made up of traditional elements, Christian and Classical, blended in various proportions. The first came from a literal reading of the Scriptures and the other-worldly attitude of the pr tagonists of the Church. It appears that Christianity spread first through the urban commercial population round the Mediterranean, whose *lingua franca* was Greek. It was only later on that it penetrated into the hinterland and overspread into the vast rural areas of outer provinces. Thus Greek science received a frontal attack in its most important centres. In this welter of ignorance and refutation of earlier knowledge, interest in science and rational geographic concepts could be retained only by a handful of people in the lands of Christendom. Only the Nestorians, the Monophysites and some of their adherents kept a semblance of Greek Science preserved.

But there were new historical forces in the making to carry forward the torch of culture and civilization. During the 7th century there arose one of the epoch-making popular movements in the memory of man from the depths of the Arabian Peninsula and it brought about the establishment of one of the greatest empires. Thus the Arabs conquered a large number of peoples who were superior to them in culture. Nevertheless the conquerors did not lose their national

characteristics and subjected Syria, Mesopotamia, Egypt and North Africa to their ethnographical influences. There was no religious persecution and in a few generations Islam became the religion of a large majority of population and even those who did not embrace Islam adopted the Arabic language. The Christian doctrine was based primarily upon faith, while Greek philosophy was an attempt to interpret experience rationally. The Muslim Scientists tried to combine the loyalty to their intelligence with that of their hearts and this could only be done by the reconciliation of faith with reason. It has been admitted that Islamic thought is world accepting and, therefore, Muslims are interested in material development. Further, Muslim basically look forward rather than inward and thus are open to scientific attitude to life with its emphasis upon the reality of nature and the external world. Muslim belief in astrology was both weak and conditional. For instance, it was held (and still is) that all events happen by the will of God; they could not be controlled by the stars. The stars were indications rather than rulers. But the Jews recognised the stars as rulers and as lights of heaven to rule the earth and in this they were followed by the Christians.

As soon as early conquests were over and contact had been established withGreek and Indian knowledge, Muslims became imbued with tremendous curiosity and took up the cause of science with enthusiasm from different centres of their culture. Early Islamic attitude to science was one of tolerance, even enlightened interest. It is evidenced by the continuance of the

academy at Jundī-Shāpūr, as a scientific centre in the Empire. Scientists from this centre in Persia were welcomed at Damascus the capital of the Umayyad Caliphate. These men were mostly Christians and Jews.[1] Further, the Arabs were traders, travellers and lawyers and they had a somewhat positive minds and, therefore, practical sciences appealed to them. Arabic was suitable for exact and precise sciences and lent itself more easily to the formation of technical terms. Geography especially appealed to them, because of its utility to serve the needs of commerce, the division of land, travel through the deserts, knowledge of the plants and animals and in finding the azimuth of Mecca and the phases of the moon.

The Arabs had a traditional interest in matters concerning geographical knowledge. Even before the birth of Christ and after, they were among the foremost traders and navigators of the Arabian sea, Indian Ocean and Chinese Seas. The Arabic language of that period abounds in words for ships, boats, condition of the sea, surface, storms, heavenly bodies and commodities of exchange and trade. These activities were greatly influenced by the geography of the Arabian Peninsula. Its midway position between the East and the West and the littoral situation of all its fertile lands in Yemen, Yamāmah, 'Oman, and Baḥrein, etc. Even the Ḥijāz, though largely arid, lay along the trade routes from the Arabian Sea and Red Sea to the Mediterranean world.

Pre-Islamic poetry contains references to naviga-

1. Max Meyerhof: *Science and Medicine*; *The Legacy of Islam*, p 314.

tion and sailings and the Holy Qur'ān itself abounds in navigational terminology and descriptions, of conditions of the seas and ships and boats used. There was a close relationship between land journeys as well as sea voyages with the knowledge of stars and other heavenly bodies. The inland Arabs, with scanty agriculture and nomadic economy, were always face to face with such problems as sources and extent of grazing opportunities, distribution of desert plants and animals, and the nature of gemorphological features. Therefore, Arab interest in geographical matters was a deep one. It needed various stimuli such as extension of terirtorial influence, expanded trading opportunities, greater cultural contact and a vigorous religious zeal to widen the frontiers of geographic knowledge.[1]

Within a few years of the advent of Islam, the Arab victories brought them a rich reward in the conquest of prosperous lands and cultured communities, from the Mediterranean to India and Central Asia. On the one hand, the Arabs became the heirs of the Hellenistic Culture for which a way was earlier opened by the conquests of Alexander. On the other, they reached the homeland of Indian Culture and Buddhist and Iranian thought. It is rightly assumed that the Arabs became the pupils and successors of Greeks in Science and through their efforts and ingenuity perfected it for the future protagonists.

From the point of view of the development of

1. M. Sulaymān Nadvī : *'Arbon Ki Jahāzrāni* (Urdu), p. 165.

science transmission is as essential as discovery.[1] There is some analogy between civilization and infectious disease, as both are passed on from one community to another by contact. After their foundation, Kūfa and Baṣra became great centres of Islamic religious learning, Hira the important Nestorian centre was close to Baṣra and intercourse was established between them. The Muslim scholarly tradition was ḍeveloped early in Baṣra. It is a fair surmise that the Nestorian heritage of Greek scholarship passed from Edessa and Nisibis through Jundī-Shāpūr to Baghdād after its foundation in 762. Another source of transmission of Greek culture and knowledge to the Arabs were the Monophysite centres of learning which were monastries, not academies like those of Nestorians at Jundī-Shāpūr.

The Indian influence in the first instance was the product of a continuing commercial contact via the sea route from Ujjain, the town of Brahmagupta (c. 628) the famous writer of the astronomical manual *Brahma Sidhanta*. Muslim conquest of Central Asia brought them into touch with Buddhism and old Greek colonies in the regions of Bactria, Sogdiana, Ferghāna and Marw.

The establishment of the 'Abbāside Caliphate in 750 A.D. ushered in an age of glory, power, pomp and splendour, culture and prosperity for peoples under Muslim rule. Scientific activity took its birth and in this process the inauguration of translation activity at Baghdād systematically organised under a Baitul-

1. Sarton : *Introduction to the History of Science*, Vol. I, p. 15.

Ḥikmah (Translation Bureau) was a tremendous step forward. The Bureau had a library and a permanent personnel and services of translators were commissioned from far and wide. Manuscripts were even paid for their weight in gold. The main aim was to make available in the Arabic language the wisdom and the sciences of the Greeks and others. Among the translators was the dominating figure of Ḥunain Ibn Isḥāq who besides being a scientist was a linguist having a mastery over Greek, Syriac or Aramaic and Arabic. Translations included works in many sciences by an array of able translators. Among the sciences which received special attention were physics, meteorology, mineralogy, botany, astronomy and geography. The early phase of translations was more concerned with medical and philosophical works, but later on mathematical, astronomical and geographical subjects received more attention. The Caliph Al-Māmūn took active interest in the work of his translators and scientists. Among his great achievements was the measurement of a degree of the earth's arc in the plains of Sinjār west of Moṣul and the construction of a world map. Both the tasks were of great significance to geography and were accomplished by a team of scientists.

The period of early translations was of great importance in the developing intellectual and scientific life of Muslim Society. The Greek writers who influenced the Arab scholars most were not poets, historians or orators but mostly the scientists in various fields such as mathematics, astronomy, medicine, philosophy and geography. For instance, the

scientific method of Aristotle received far greater attention than the writings of Plato and Socrates.

Before the content of Muslim contributions to geography is examined, a few points must be clarified. The birth of scientific activity under Islam has indispensable relevance to Muslim geographic thinking. The passage of Greek science to the Arabs revealed to them Hellenistic geographic concepts which had received slashing denunciations by orthodox Christian writers, examples of which are far too many. Therefore, the first task of Arab geographers was the revival of older science. The term "Arab" must be taken in a broad sense. It not only denotes those of Arab blood but includes all those who were politically and culturally under Muslim domination. They used the Arabic language in ordinary intercourse as well as literary pursuits. On the whole, it was the sameness of culture and the way of life which may be appropriately labelled "Muslim". In this context, "Arab and Muslim" have been used interchangeably.

The Arab interest in matters geographical was largely born of the environment in which they lived. The knowledge of the fixed stars, the movements of the planets and other heavenly bodies and of the changes of weather were of practical interest to them, and were carefully observed for the purpose of travel over the vast expanses of the desert, whether for purposes of war or peaceful movement. Flocks and herds, the most precious possession of the dwellers of the desert, had to be moved from time to time in search of fresh and better pastures. The knowledge

of plants and wild animals of the desert was obviously acquired during such wanderings Much information of tribal history and the physical surroundings of such human groups was enshrined in poetry and eloquent speech, lore and rhetoric. It is not surprising therefore, that before the birth of the scientific geography of the Arabs, are found contributions which deal with matters geographical.

The majority of Arabic geographical authors looked upon Ptolemy's 'Almagest' المجسطى and 'Geography' with respect and many an admirer followed the tradition of the Alexandrian who had given a mathematical and astronomical bias to his labours.[1] Thus a beginning was made with Muslim astronomical and mathematical geography. Though geographical matters had already attracted the attention of Arabic writers[2] who dealt with the geography, historiography and archaeology of Arabia, i e., Abu Ziyād al-Kilābī, an-Naḍar b. Shamīl (d. 204 A.H.), Hishām al-Kalbī (206 A.H.), Sa'dān b. al-Mubārak and Abu Sa'īd al-Asmā'ī (d. 213 A.H). Aided by their own native genius, by the keenest inter-regional competition—for their culture radiated from a number of centres, spread out from Andalus (Spain) to the confines of China—and the stimulus of the classical models, they succeeded in advancing the cause of every known science. With the spread of the wave of Islamic conquest, the supremacy of the Arabic language over all other national

1. The first translation of the *Almagest* by Nairizi was of great consequence.

2. Maulana Sulaymān Nadvī: *'Ilm al-Jughrāfia al-'Arab, ad-Din*, September, 1932.

languages came to be established and, in addition, this homogeneity of the medium of expression and to a large extent of religious belief led to the growth of a common culture, in the midst of which grew up the learned of all nationalities and sects. Islam, to millions of people was a culture as well as a religion and the Arabic language was the language of science. Geography specially interested the Muslims because they had early felt the need for the accurate determination of the position of places. For the 'children of the desert', astronomical knowledge was of great interest and had much utilitarian value. The relationship between that science and mathematics is close and the knowledge about the position of stars leads to the determination of latitude and longitude. Thus mathematical geography and cartography came in for early attention.

The expansion of political power and the establishment of a great brotherhood made the information about the lands of Islam one of ever-increasing interest. Here one should not forget the great impetus to inquisitiveness provided by the annual congregations of the Ḥajj at Mecca. To the Muslim it was not a matter of choice; it was his positive duty within the limits of possibility to undertake it. Thus ran to Arabia a constant stream of visitors hailing from every nook and corner of Dār al-Islām (Islamic lands).

The Ḥajj, thus remained a unique assembly of Muslims which gave them an initiation into the great world of Islam, providing vast opportunities for an exchange of views and the narration of experiences in

travelling, when thousands of Muslims of different races, coming from a variety of social and physical environment, met their co-religionists. It was for scholars, the exact equivalent of modern journeys abroad for studies. The years spent to and from Mecca and Medina with the slow pace of medieval communications, were the 'Wander Jahre' of Muslim students young and old.

The Arabic narratives of Muslim pilgrims are far superior to those of the Christians and their scientific value is much greater. *The Travels of Ibn Jubair* (ابن جبیر رحلة, 1183-85), guide book of Persian Al-Harawī (اشارات على معرفة الزيارات, d. 611-1214), Al-'Abdarī's (Abu Muḥammad of Valencia), *Accounts of Journeys through North Africa* (الرحلة المغربية, 688-1289) and Muḥammad Ibn Rushaid's account are outstanding examples of such geographical literature. The travellers had many-sided interests and possessed a keen sense of observation and took pains to obtain information of various kinds and liked to meet famous scholars.

Through the organisation of the postal system (the 'barīd') and the development of routes and communications attendant on the establishment of a vast empire, incentive was provided for the appearance of many route books (*Kitāb al-Masālik wal-Mamālik*). In this category come many famous geographical works bearing this title, i.e., Ibn Khurdādhbih, Iṣṭakhrī, Ibn Ḥawqal.

GENERAL SURVEY

There were persons who spent many years in

travelling throughout the Islamic lands and some even visited far-flung non-Muslim regions and as a result of their experiences wrote remarkable accounts of their travels, often embodying valuable geographical information. Most of such travellers visited the holy places but in many cases their pilgrimages were incidental. Ibn Ḥawqal, Mas'ūdī, Maqdīsī, Idrīsī, Abu'l-'Abbās al-Nabātī of Seville, Ibn al-Baiṭār of Malaga both noted botanists and Ibn Baṭṭūta were great travellers. Among the sailors there were Sulaimān Tājir (merchant), Buzurg Ibn Shahriyār, Ibn al-Mājid and Sulaimān al-Mahrī. They have left a geographical literature of far-reaching importance.

Another class of geographical literature consisted of descriptions of specific regions in many details. Among earlier works of this kind may be mentioned the work of Khatīb Baghdādī, 1071 A.D. (a topographical study of Baghdād). Among the later works, there are several worthy of attention, e.g , Ibn al-Balkhī's description of Fārs (1110 A.D.) in Persian, Ibn Jamī's description of Alexandria and its climate and 'Abd al-Laṭīf's description of Egypt. These constitute some of the most important topographical works of the Middle Age.

Regional geography received early attention and these writings contain an enormous wealth of detail and information. The wide variety of outlook and keen observations of many geographers of this early period make a fascinating reading. As time went on, the writings of notable travellers, the specialist studies of the topographers and the critical works of socio-

geographers lent a great variety and colour to the content of Muslim geography.

Geographical knowledge of certain regions and areas was particularly advanced. Among these the following may be mentioned :

1. *Volga-Caspian, Northern Europe and Siberia.*— Besides possessing the Greek and Roman knowledge of lands and seas, the Arabs were better acquainted with four other regions hitherto only vaguely known.

Strabo's and Ptolemy's knowledge about the regions round the Caspian Sea and areas to the north-east of the Black Sea was very scanty. Pliny regarded the Scythians as cannibals, while Ptolemy's Sea of Azov extended to the site of Moscow. The Sea of Aral was not mentioned at all. The lake of Khwārizm (Aral) was represented for the first time on a map in Caliph Al-Māmūn's times.

Many expeditions were sent in this direction from Baghdād. In 921 A.D. Ibn Faḍlān went as an envoy to the court of Volga Bulghars and wrote the first reliable account of this area. He was one of the earliest traveller-geographers. Yāqūt later on probably utilised this source in his great geographical Dictionary, معجم البلدان. Another work of considerable importance by Ibn Faḍlān was his *Risalah* which was discovered by Aḥmad Zakī Validī at Mashhad. Among other authorities, Al-Bīrūnī was the first to give the names of River Angara and of the populations of the Baikal region in Eastern Siberia. He also gave accounts

of the Scandinavian Warangians, about the metal-work in Northern Europe and provided adequate information concerning the Ice-Sea north-east of Europe.[1] Later on, numerous Arab traders visited these parts and extended their activity particularly to southern Russia and Poland, Scandinavian countries too did not escape their notice and the recent discovery of a large number of Arab coins found in places as far north as Russia, Finland, Sweden and Germany, testify to the world-wide commercial activity of the Muslims of this and the later period.

2. *Africa and Adjoining Seas.*—The Greeks and Romans had frequented the East African coast and the former had founded some coastal settlements. But their activity at all periods was confined to the littoral portion and the tropical heart of Africa remained unknown to them. From these contacts Europe only inherited a legacy of fantastic fiction, and the Roman "Africa" largely meant Mediterranean coastal regions and the bordering desert fringes and Egypt. Soon after the conquest of Egypt, the Arabs penetrated into the Sahara and the zeal to spread Islam as well as the the wings of commerce brought them into contact with the lands south of the vast desert. With the establishment of contact and friendly relations with the Sudan (1076), on the one hand, they reached the Senegal and the Niger and on the other probed into the secrets of the Upper Nile Valley. Many years passed, however, before the peoples of Christian Europe figured directly in this trade, partly from their

1. Prof. Aḥmad Zakī Valīdī : *Islam and the Science of Geography*,—Islamic Culture, Hyderabad, Vol. VIII, 1934, p. 513.

anti-Muslim prejudice and partly because it was not within their power to enter the field in the face of Islam's domination. Along the east coast of Africa. Muslims claimed many early maritime adventures and actually penetrated as far as the coast of modern Natal.

There were several notable geographical works on which the Arab knowledge of Africa was based. Among early sources was Muhallabī, who was the author of an outstanding geographical work dealing with the Sudan, which was written for the Fāṭimid Caliph Al-'Azīz in 375 A.H /985 A.D. It was the first book of its kind about this area and later formed Yāqūt's main source for the geography of the Sudan. The great Al-Bīrūnī personally obtained valuable information about South Africa and Mozambique (his Safālatu'z-Zanj) from Muslim merchants. On the basis of such information he was not only able to remark that "During our summer (there) winter prevail", but could also suggest that the southern sea (Indian Ocean) communicates with the ocean(Atlantic) through a gap in the mountains along the south coast (of Africa). He added, "One has certain proofs of this communication, although no one has been able to confirm it by sight."[1] Later in the mid-twelfth century, Idrīsī through his geography '*Nuzhat al-Mushtāq fī Ikhtrāq al-Āfāq*, provided information with indisputable accuracy about the Niger above Timbuktu and of the region of the head-waters of the Nile and large tracts of the Sudan. The accuracy and point-

1. Sachau : *Al-Birūni's India*, Vol. I. p. 270. Also Reinaud : *La Geographie d'Aboulfeda*, Vol. II, pp. 14-15.

edness of Idrīsī's information about Africa excites the admiration of modern geographers.[1]

3. *Chinese Border, Central Asia and South Asia.*— A study of pre-Muslim geographical literature reveals the vague and scanty knowledge possessed by the West about the great interior of Asia. About South Asia including India, the information of historians like Herodotus, the Greek and Roman geographers and merchants was equally meagre. Soon after the Muslim conquest of Transoxiana (Māwrā al-Nahr), they rapidly pushed on to the vast Central Asia area buttressed on the east by the lofty peaks of the Chinese mountain ranges. In the earlier phase of Muslim geographical writing, there appeared native geographers such as Jaihānī (Minister at Samanid Court, 892-907 A.D.), Gardīzī, (the author of *Zain ul-Akhbār*), the writer of *Ḥudūd al-'Ālam*, 'Balkhī' and 'Al-Bīrūnī', who added valuable information about this area. The Muslims began to play a leading part in the administration, commercial and cultural life of Central Asia and their knowledge is reflected in the historico-geographical works of this period. After the Tartar inundation had passed and once more life returned to normal conditions, it emerged enriched with the Mongolian and Turkish contact. On the one hand noted travellers like Juwainī, Ibn Baṭṭūṭa and 'Abdur Razzāq went over a large part of this area and have left many-sided and useful descriptions. Their accounts may be rated higher than those of Polos in value, because these Muslim travellers, sprang up from the same cultural

1. Kimble: *Geography in the Middle Ages*, p. 59.

milieu as the vast population of these regions.

Rashiduddīn, the Grand Vazir of the Mongols who had access to valuable sources of information, wrote his monumental *Jāmi' at-Tawārīkh* (History of China, India and Europe) and the book of geography, *Ṣuwaru'l-Aqālīm* (which remains undiscovered). Muslim geographers at the time of the Mongols had, therefore, an influence over the geographical science of the Chinese. Thus the Chinese official map for the year 1331, as Albert Hermann has pointed out, was composed either in dependence on Muslim geographers or by Muslim geographers themselves.[1]

The knowledge about India also, in spite of the epoch-making invasion of Alexander and some Roman commercial activity in the Indian Ocean, was scanty. Soon after the Muslim conquest of Sind and south-western Punjab, the Arab world began to get first hand information of Hind (India). The traders and settlers along the Konkan and Mālābār coasts through their friendly relations with native populations could observe things close at hand. Sulaimān Tājir (merchant) 237 A.H./851 A.D. who travelled India and China and Abū Zaid Sīrāfī who compiled his work a little later, in *Silsilat al-Tawārīkh*, provided some of the earliest information on Indian geography and social and economic conditions. The observations of great travellers like Ibn Ḥawqal and Mas'ūdī who wrote at length about Makrān, Sind and the west coast of India. Geographers like Ibn Khurdādhbih, Iṣṭakhrī and

1. Prof. Ahmad Zakī Valīdī: *Islamic Culture*, Hyderabad, Vol. VIII. 1934, p. 514.

Maqdīsī also treated India in detail. However, the Muslim geographers of this period only spoke of that part of India with which the Arab world was in direct contact, *i.e.*, west of the geographical barrier of the Thar Desert and the Shishahdri Mountains (Western Ghats). Then came the Muslim advance into India through the passes of the north-west in the shape of the Ghaznivid penetration. The great scholar Al-Bīrūnī came to India, studied Sanskrit, Indian arts and sciences and produced his monumental work *Kitāb ul-Hind*, in which he gave a detailed geographical picture of the country. Idrīsī, Abu'l-Fidā and Ibn Baṭṭūṭa later gave plentiful information about India, so that this land of spices, silver and gold and old culture did no longer remain a mystery to the Muslim world.[1]

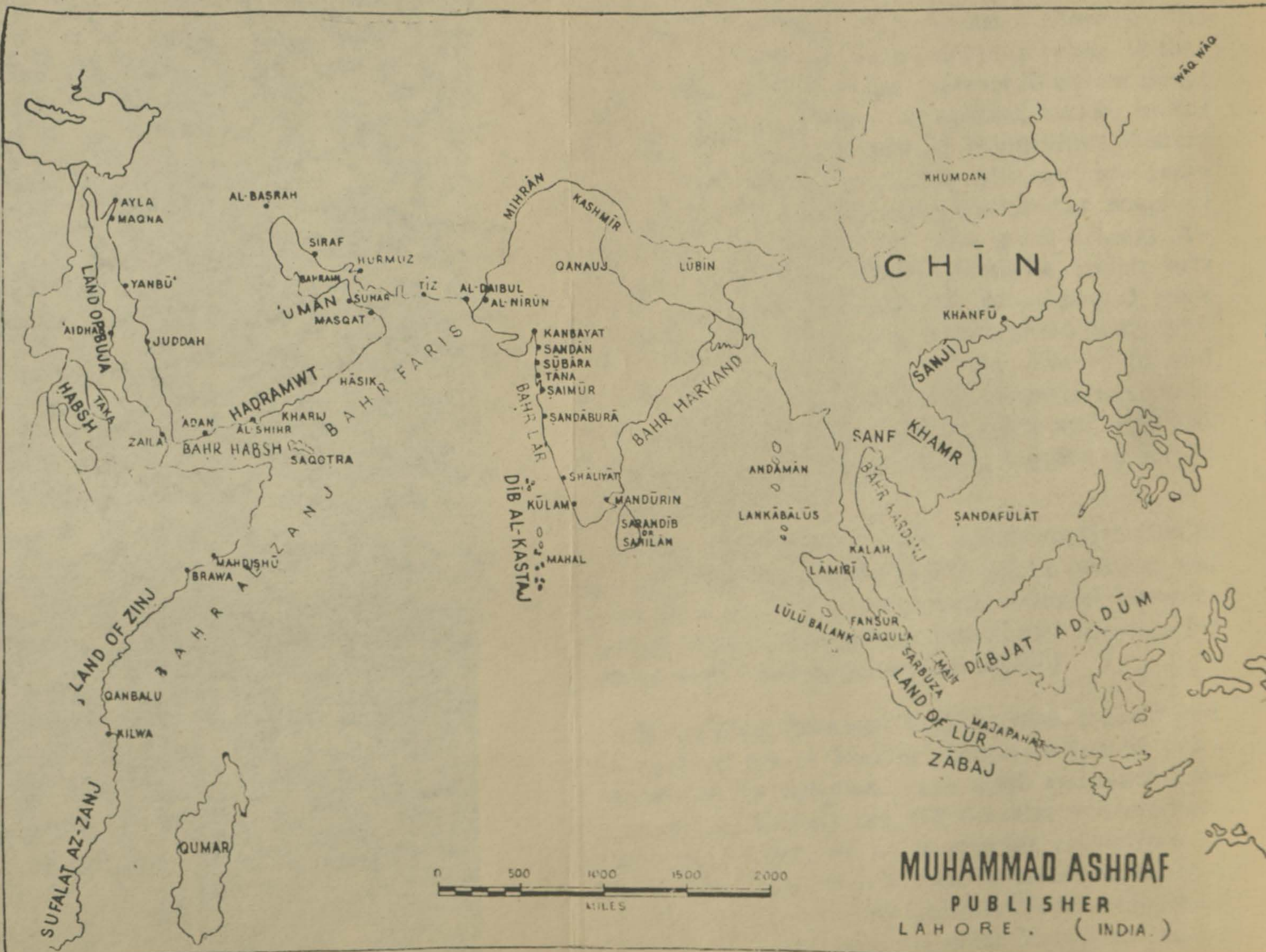
These geographers made a great contribution in the sense that their works laid stress on cultural and sociological matters. The determination of latitudes and longitudes of numerous places and the data for serious routes and stages is very explicit.

It has often been said that the most fruitful and the classical age of Muslim geography passed away with the works compiled in the ninth and tenth centuries of the Christian era, and the later writings were either mere repetition or incoherent collections of information. But such a view is based chiefly on a lack of knowledge of many later works which till today remain untranslated into the great European langu-

1. See Nainar: *Arab's Knowledge of South India* (Introduction). Also Elliot: *History of India*, Vol. I, Ch. I—IX.

INDIA, EAST AFRICA AND FAR EAST

AS KNOWN TO THE ARABS FROM 8TH TO 14TH CENTURY A.D.



ages. This is not to deny that in many works is found a mixture of fact and fiction. Therefore, it remains to analyse these works on the subject.

In the writing of world history, unfortunately, quite often, clerical and narrow national and racial prejudices have been responsible for the fabrication of untrue stories and invention of so called 'facts'. Such an attitude has left a legacy that has buried the truth for centuries. Today with the help of honest and scholarly students of history and sympathetic Orientalists much of this cover is being removed.

Lastly, the study of the cultural history of the Islamic world should no longer be considered the special and narrow domain of philologists and Orientalists, but a subject of research and understanding of world culture by all students of the history of mankind. Thus, among the sources that need be consulted, the study of the vast Muslim historico-geographical literature is indispensable.

The next chapter provides a summary of the work of geographers during different periods and in many parts of the Islamic lands.

CHAPTER II

THE GEOGRAPHERS AND THEIR WORKS

THE earliest known Muslim writing dealing with geographical matters was that of Hishām b. Muḥammad al-Kalbī (d 820 A D), who is regarded as an excellent authority for the history of the pre-Islamic Arabia. But only a few fragments[1] of his work are extant. He is said to have written ten books consisting of geographical topics. Though he was mainly a writer on Arabia, it is surmised that he had also dealt with other subjects.

The work of Muḥammad b. Mūsā al-Khwārizmī laid the foundations of Arabian geographical science. His 'Kitāb Ṣūrat al-Arḍ' (كتاب صورة الارض, Shape of the Earth) was written in the first half of the ninth century A.D. The exact date has not been fixed, but, according to Wiedemann, Khwārizmī took part in the scientific activity which flourished during the times of the Caliph Al-Māmūn (813-33 A.D.) and it is believed that his work is connected with the famous map of the world drawn by many scholars for the Caliph. Although Barthold has suggested that the work was probably compiled in the days of Mu'taṣim, the succeeding Caliph, as the new capital Samarra (Surra-man-ra'a) is mentioned by Khwārizmī. As to the merit of the

1. M. Sulaymān Nadvī : *Arḍ al-Qur'ān*, Vol. I, p. 16, says that a few fragments of Kalbī's works are available, while Kremer in *Encyclopaedia of Islam*, Suppl., says that none has come down to us. S. Nadvī calls him the author of *Kitāb al-Nawādir*.

work, Nallino[1] remarks that it is a work the like of which no European nation could have produced at the dawn of its scientific activity. In Khwārizmī's work is found along with geographical names of the Muslim period a great number of ancient names also.

The famous philosopher, Al-Kindī (Abū Yūsuf Ya'qūb) was a younger contemporary of Khwārizmī and died in 260 A.H./873-4 A.D. He wrote a geographical work under the title of 'Description of the Inhabited Part of the Earth' (Rasm al-Ma'mūr min al-Arḍ). A pupil of Kindī, Sarakhsī (Aḥmad b. Muḥammad b. aṭ Ṭayyib) who died in 899 A.D. was the author of a book on 'Routes and Kingdoms' (Kitāb al-Masālik wa'l-Mamālik). He also wrote on 'Seas, Waters and Mountains' (Risālah) fi al-Baḥār-wa'l-Miyah wa'l-Jibāl). About the same time one of the leading mathematicians, Abu'l-Ḥasan Thābit b. Qurra (836-901 A.D.) translated Ptolemy. But to Sarakhsī, who was a native of Khurāsān and worked at Baghdād, goes the credit of producing a work which was more 'geographical' than astronomical and mathematical in outlook.

One of the earliest geographical works of this period is that of Ibn Khurdādhbih (Abu'l-Qāsim 'Ubaidullah ibn 'Abdullah), who was descended from a Persian family and was brought up in Baghdād, where he made the acquaintance of the celebrated musician, Isḥāq of Mawṣil. He also studied literature along with music. Later on he was appointed the chief postmaster of Jibāl province and it seems he utilised his official position to obtain much useful

1. Minorsky : *Ḥudūd al-'Ālam*, (Barthold's Preface, p. x).

information about distant regions. Between the years 844 and 848 A.D., he was at Samarra on the Tigris, and it was then that h wrote his famous 'Kitāb al-Masālik wa'l-Mamālik' (on Routes and Kingdoms) an outstanding work of its kind. It gives a summary of the main trade-routes of the Arab world and in addition provides descriptions f such distant areas as China, Korea and Japan. Though in several places facts are mixed with ction and hearsay, later geographers invariably consulted this work and it is surprising indeed that, unfortunately, only an abridged version of this book has been handed down to posterity.

A work of the same period is that of a Bedouin, Arrām b. al-Asbaj as-Sulamī, written about 231 A.H./845 A D. known as 'Kitāb Asmā' Jibāl Tihāmah wa Makāniha' which deals with the mountains of Tihāmah in Arabia. This work is mentioned by as-Sirāfī. Yāqūt, the famous thirteenth century geograph r, also mentions another book by the same author bearing the title 'Jazīrat al-'Arab' (Isle of Arabs). This reference is found in the 'Dictionary of Learned Men'—'Mu'jam al-Udabā',' Vol. III, p. 86.[1]

A geographer of outstanding fame was Ya'qūbī (Aḥmad b. Abī Ya'qūb b. Ja'far b. Wahab b. Wāḍeh al-'Abbāsī) who was an Egyptian of the family of Abbasid Caliphs and a Shi'ite.[2] He was at the Tāhirid Court in Khurāsān and was a widely travelled man, having visited India and the Maghrib (N.W. Africa) Ya'qūbī came back to his native land after his exten-

1. Brockelmann : Supplement, Bd. I.
2. Huart : *History of Arabic Literature*, p. 292.

sive wanderings and died there in 284 A.H./897 A.D. He wrote something resembling a modern gazetteer, called 'Kitāb al-Buldān' (Book of Countries) in 278 A.H./891 A.D. The work gives details about numerous places and in several places attempts are made to state facts of physical geography in explaining the human geography of many areas. It begins with a detailed description of Baghdād and Samarra, and then deals with Irān, Tūrān and what is now modern Afghānistān. Topographical details of Kūfah and Baṣrah are provided and then follow descriptions of Central and South Arabia, Syria, Egypt, Nubia and the Maghrib. But it is unfortunate that chapters on India, China and the Byzantine Empire have been lost.[1] Details of the high roads across Irān are found fully set forth only in this work. He was particularly interested in the statistical and topographical aspects. Ya'qūbī is sometimes popularly called the "father of Muslim Geography." Perhaps, this is due to the fact that his work received early attention in the West.

Ja'far b. Aḥmad al-Marwazī (d. 274 A.H./887 A.D. wrote his 'Kitāb al-Masālik wa'l-Mamālik' which seems to be of considerable importance, as it was mentioned by Ibn al-Nadīm in his "Fihrist" (p. 150) and also by Yāqūt in 'Mu'jam al-Udabā' (Vol. II, p. 400).[2]

Al-Balādhurī (Aḥmad b. Yaḥya b. Jābir) was a great historian, whose reliability and critical powers are much appreciated by scholars. Though he was not

1. *Encyclopaedia of Islam*, Vol. IV, p. 1153.
2. See Brockelmann : Supplement, Bd. I.

primarily a geographer, he discussed geographical topics in many parts of his writings. For example, he refers in his 'Futūḥ al Buldān' to the bursting of the banks of the Tigris in the Sāssānian period. He was educated at Baghdād during Māmūn's times and wrote 'Futūḥ al-Buldān' about 862 A.D. According to Yāqūt in 'Mu'jam al-Udabā' ' (Vol. II, p. 131) he had written two more books, 'Kitāb al-Buldān al-Ṣaghīr' and 'Kitāb al-Buldān al-Kabīr,' which are now extinct. In 892 A D. he died of mental derangement after drinking balādhur (Indian *bhang*), hence his designation.

Al-Hamadāni (Abu Bakr b. Muḥammad b. Isḥāq b. al-Faqīh) was born in Hamadān, a famous city of Irān. He flourished during the reign of Al-Mu'tadhid at Baghdād and is known as the author of a geographical miscellany, 'Kitāb al-Buldān' (Book of Countries) which was probably written in 902 A.D. We possess only an abridgement made by 'Alī ibn Ja'far Shaizarī (413 A.H./1022 A D.).[1] It appears to be an important work and is often quoted by Mas'ūdī and Yāqūt.

Ibn Rustah (Abu 'Aī Aḥmad b. Muḥammad b. Isḥāq b. Rustaḥ) was the author of an encyclopaedia (Al-A'lāq al-Nafīsah), the seventh volume of which (now in the British Museum) deals with geography. Hiṣ work was compiled at Iṣfahān in 290 A.H /903

1. This work has been edited by Prof. Aḥmad Zakī Validī of Turkey and the text of the epitome of Ḥamadāni's work forms the 5th Vol. of *Bibl. Geog. Arab.* Ed. de Goeje, Leiden, 1885. Also see Le Strange : *Palestine under the Muslims*, p. 4.

A.D. Though Ibn Rustah's geographical writings have an astronomical bias, his discussions deal with a variety of topics, like the extent of the earth, the founding of Mecca and Medina, seas, rivers, climate, as well as the geography of Irān and the adjoining lands.

But to geographers of great interest is his minute account of the great Khurāsān road as far as Ṭūs (near modern Mashhad) with some of its branch roads, notably those going to Iṣfahān and Herāt; and also the roads from Baghdād to Kūfah and Baṣrah with its continuation to Shīrāz. In addition to remarks about exact distances and important stages on these roads Ibn Rustah describes the relief of the areas traversed, and this has helped in fixing of the sites of several towns which no longer exist.

Ibn Serapion is an obscure geographer and only a few details about him are known. He was a Copt (Egyptian Christian), and compiled his work about the year 945 A.D., after the capture of Baghdād by the Buwaihids. He is said to have made a chart describing 'Irāq with special reference to Baghdād and parts of Mesopotamia. He wrote about the river and canal system of Mesopotamia and added brief descriptions of rivers in other provinces. Le Strange utilised Ibn Serapions work in connection with his two well known books.[1]

Ibn Faḍlān (Aḥmad b. Faḍlān b. 'Abbās b.

1. *Lands of the Eastern Caliphate* and *Baghdad under the Abbasid Caliphate.*

Rashid b. Ḥammād) is one of the earliest traveller-geographers, whose accounts of the Volga-Caspian regions are greatly valued. He was sent by the Caliph Al-Muqtadir in Ṣafar 309 A.H. (June 921 A.D.) as an envoy to the king of the Volga Bulghars, where he arrived on the 13th Muḥarram, 310 A.H. (11th May, 922 A.D.). On his return to Baghdād, he described his journey in the form of a book which is perhaps the first reliable account of an area about which very little was known till then. Yāqūt later on probably utilised this source in his famous work 'Mu'jam al-Buldān.'

Another work of considerable importance by Ibn Faḍlān is his 'Risālah' (epistle) which has recently been discovered by Prof. Zakī Valīdī at Mashhad.[1]

Abu'l-Farāj (Qadāmah b Ja'far al-Kātib al-Baghdādī was a Christian accountant in the Revenue Department at Baghdād who died in 948-49 A.D. He wrote 'Kitāb al-Kharāj' (Revenue Book), in 928 which deals with land-tax, but in the introduction the author deals with the organisation of postal services and provides a summary of the geography of the Arab Empire and the adjoining countries.

Al-Jaihānī (Abu 'Abdullah Muḥammad b. Aḥmad) was a minister at the Sāmānid Court between 279-295 A.H. (892-907 A.D.). He compiled a work on the lines of Qudāmah's 'Kitāb al-Kharāj.' This work has been lost, but Sprenger is of the opinion that perhaps

1. Prof. Z. Valīdī's contributions in *Journal Asiatique*, Vol. 204, p. 144, and *Geographische Zeitschrift*, 1934, Vol. I, p. 368.

Idrīsī utilised it in describing many parts of Asia. Another outstanding traveller-geographer was Abu Dulaf (Mis'ar b. al-Muhalhal al-Khazrajī al-Yanbū'ī). He was born at Yanbū' near Medina and later lived as a poet at the Court of the Sāmānid Prince, Naṣr b. Aḥmad b. Ismā'īl, from 301-331 A.H. (913-942 A.D.). In 331 A.H. (942 A.D.) an Indian envoy is said to have come to this court on a mission of goodwill from an Indian Prince, Kalatlī b. Shakhbar [1] Abu Dulaf went with the mission on its teturn journey and visited Kashmīr, Kābul, Sīstān, and the Mālābār and Coromandal coasts. On his return he wrote 'Ajāib al-Buldān' (Wonders about Countries). This work was later utilised by Yāqūt and Qazwīnī.

Al-Balkhī (Abu Zaid Aḥmad b. Sahl) was born near Balkh in Shāmistān. He went to 'Irāq for his education and became a pupil of the famous philosopher Al-Kindī, under whom he studied history and philosophy. On his return to his native land, he took up service under the prince of Balkh (Aḥmad b. Sahl b. Hāshim al-Marvazi, who died in 307 A.H./919 A.D.). Balkhī is one of the early Muslim map-makers and most of his work in 'Kitāb al-Ashkāl' or 'Ṣūrat al-Aqālīm' (Figures of Climes) consists of explanations of charts. He also wrote on 'Routes and Kingdoms' (Kitāb al-Masālik wa'l-Mamālik). His works were compiled in 309 A.H./921 A.D. and he died in 322 A.H./934 A.D. Balkhī wrote about China, India and several eastern countries.[2]

1. Brockelmann, p. 228.
2. Sarton: *Introduction of History of Science*, Vol. I, p. 621.

Another geographer about whom few biographical details are available is al-Iṣṭakhrī (Abu Isḥāq Ibrāhīm b. Muḥammad al-Fārisī), who must have lived in the first half of the fourth century A.H. (10th A.D.) as there is evidence of his contact with Ibn Ḥawqal in 340 A.H./951-52 A.D. or, according to De Goeje, between 318-21 A.D. Iṣṭakhrī wrote on 'Routes and Kingdoms,' and his book is based upon Balkhī's earlier work of the same name. In his work also maps play an important part and he made coloured maps for each country. He was a native of Iṣṭakhr in Fārs (Irān).

Ibn Ḥawqal (Abu'l-Qāsim Muḥammad) is noted for his extensive travels which lasted no less than 30 years. He left Baghdād in Ramaḍān 331 A.H./May 943 A.D. and travelled throughout the Muslim world gathering a store of knowledge and experience. He had studied Khurdādhbih and Jaihānī and met Iṣṭakhrī in 340 A.H. and at the latter's request revised his work and maps, but later on rewrote and amplified it under the same name in about 367 A.H/977 A.D. Dozy believes that he was a spy in the service of the Fāṭimids; but that does not detract from the merit of his compilation and labour.

Al-Mas'ūdī (Abu'l-Ḥasan 'Alī b: Husain) is famous as a traveller, historian and a geographer, and was certainly one of the most versatile of the fourth century writers. He belonged to an Arab family and was born at Baghdād. Mas'ūdī acquired a 'Wander-lušt' early and in his youth travelled far and wide, visiting various parts of India, especially Sind, the Punjab, Konkan and Mālābār and after passing through Ceylon

went onward to the China Sea, returned to Zanzibar and Madagascar and later arrived back in 'Umān on his way to Baghdād. After a short while he travelled along the southern shores of the Caspian Sea and visited Asia Minor, Syria and Palestine. In 305 A.H./ 915 A.D. he was in Iṣṭakhr. He came to Egypt during the later years of his life and died at Fusṭāṭ in 345 A.H /956 A.D. It seems that Mas'ūdī had made a thorough study of the geographical literature available in his times and, therefore, he has been able to mention numerous works now not extant. Many of his geographical ideas are traceable to Kindī and Sarakhsī and he himself mentions meeting Abu Zaid Sīrāfī. But in several places he breaks fresh ground as a result of his deep observation, vast experience and extensive knowledge. 'Murūj al-Dhahab wa Ma'ādin al-Jawāhir' (Meadows of Gold and Mines of Precious Stones) is a record of Mas'ūdī's travel experiences and observations and can be called a historico-geographical Encyclopaedia. Fortunately, the text of this great work written in 947 and revised in 956 is available to the modern reader and reveals the writer's geographical ideas. He discussed earthquakes, geological formations, nature of Dead Sea and windmills in Sijistān. His last work was 'Kitāb al-tanbīh wa'l-isrāf' which deals with questions of evolution.

Al-Ḥā'ik (Abū Muḥammad al-Ḥasan b. Aḥmad b. Ya'qūb al-Hamadānī b. al-Ḥā'ik, the weaver) was a scholar well-versed in history, but he was also a geographer of considerable merit, besides being an astronomer and a poet. He came from a Yemenite

family and was very much interested in the folklore of ancient South Arabia. He wrote 'Kitāb Jazīrat al-'Arab' (A Geography of Arabia), dealing with its physical features, races, tribes, animal and mineral products, routes and settlements, etc. He also wrote 'Al-Aklīl' about forts and graves and other archaeological remains of Yemen. Unfortunately, many details about him are not known. He is said to have died at Ṣan'ā in prison in 334 A.H./945 A.D.

Al-Maqdisī, also sometimes known as Muqaddasī (Abu 'Abdullah Muḥammad b. Aḥmad), was a native of Palestine and was born in Jerusalem in 947-48. His fame as a geographer is widely recognised in the West. Maqdisī was a great traveller and visited all parts of the Islamic world, except India and Spain. In his writings he reveals himself as a very close observer of life and professions, and seems to have a great insight into the literature of the lands which he visited. He wrote 'Aḥsan al-Taqāsīm fī Ma'arifat al-Aqālīm' (the Best of Divisions for the Knowledge of the Climes) in his fortieth year, at Shīrāz in Fārs, in 375 A.H./985 A.D. According to Maqdisī, geography had received scant attention from the scientific writers who had preceded him, and, therefore, he took upon himself the task of collecting data from all parts of the Islamic world based upon personal travel and observation, and presented them in a coherent form for the proper understanding of the life, manners, and needs of peoples. His method is best set forth in his own words:[1] "I thought it expedient therefore to engage in a subject

1. *Maqdisi*, pp. 2-3.

which they (scientists and writers) have disregarded and to single out a branch of knowledge of which they have not treated save imperfectly—and that is the chorography (geography) of the empire of Islam, comprising a description of the deserts and seas, the lakes and the rivers that it contains, its famous cities and noted towns, the resting-places on its roads and highways of communication; the original sources of spices and drugs; and the places of the growth and production of exports and staple commodities and containing an account of the inhabitants of different countries as regards the diversity in their language and manner of speech . . . the hills, plains, and mountains, the limestones and the sandstones, the thick and thin soils, the lands of plenty and fertility . . . the various states and their boundaries; the cold and the hot regions and the rural and frontier districts." It is amazing to note his similarity of approach to the conceptions of a modern geographer as regards the utility of the subject for general education. He further says: "I recognised that this subject is an all-important one for travellers and merchants. It is desired by princes and noble personages, sought for by judges and doctors of law, the delight of commoners and men of rank."

Among the geographers whom Maqdisī had consulted were Khurdādhbih, Jaihānī, Balkhī, Hamadānī and Jāhiz. He discusses their merits and drawbacks very frankly. Accompanying his description of the lands of Islam, which he divided into fourteen divisions or provinces, Maqdisī prepared separate maps[1] for each division, and in these maps he used symbols and

1. *Maqdisi*, p. 12.

methods of representation of relief, etc., for their proper comprehension by all. In his maps, routes were coloured red; the golden sands, yellow; the salt seas, green; the well-known rivers, blue; and the principal mountains, drab.

He considered the earth to be nearly spherical in shape, divided into two equal parts by the equator, and having 360 degrees of circumference, with 90 degrees from the equator to each pole. He conceived of the southern hemisphere as mostly consisting of water and the northern as having the concentration of land.[1] In connection with the description of his 'climatic' zones he gives numerous details of physical and human geography. On the whole, his descriptions of places, of manners and customs, of products and manufactures, and his brief geographical accounts of individual provinces are some of the finest pages in the whole range of medieval Arab literature.[2] Two copies of his work are available: one at Constantinople and the other in Berlin.

A geographical work of considerable importance written towards the close of the tenth century A.D. which has only recently[3] come to light is 'Ḥudūd al-'Ālam' (the Regions of the World) written in Persian by an unknown author. It was compiled in 372 A.H /

1. *Maqdisi*, pp. 99-100.
2. Le Strange: *Lands of the Eastern Caliphate*, p. 13.
3. The Russian orientalist, Capt. Toumansky had asked Mirzā Abu'l-Faḍl Gulpayagāni of Samarqand to look for old manuscripts in that area. On 25th October, 1892, the Mirzā wrote to him mentioning the discovery of *Ḥudūd-al-'Ālam*. Toumansky first mentioned the manuscript in an article in 1896—Minorsky, Translator's Preface, p. ix.

982-83 A.D., and is dedicated to Amīr 'Abdul Ḥārith Muḥammad b. Aḥmad, of the local Farighunid Dynasty which ruled in Guzganān, now Northern Afghanistan.[1] This unique manuscript was copied in 656 A.H./1258 A.D. by Abu'l-Mu'ayyid 'Abdul Qayyūm b. al-Ḥusain b. al-'Alī al-Fārisī.

The book deals with the geography of such distant lands as India, Tibet, China, Turkistan, lower Volga, Caucasus, Spain and Eastern Europe, etc. There are more detailed accounts of the author's native land. Minorsky considers it conspicuous for its well-balanced brevity and believes that perhaps it was written as a 'preface to a map' to which the author refers again and again. Unfortunately, no trace of such a map is available. He is also of the opinion that Balkhī, Iṣṭakhrī, Khurdādhbih, and possibly Ibn Ḥawqal were the sources which were largely used by the writer of 'Ḥudūd al-'Ālam.' Before describing the various parts of the inhabited world the author devotes chapters to seas, islands, mountains, rivers and deserts.

Muhallabī was the author of an outstanding geographical work dealing with the Sudan, which was written for the Fāṭimid Caliph Al-'Azīz in 375 A.H./985 A.D. It was the first book of its kind about this region and later formed Yāqūt's main source for the geography of the Sudan.

Al-Bīrūnī (Abu Raiḥān Muḥammad b. Aḥmad) has rightly been called one of the greatest scientists of all times. He holds a unique position among Muslim

1. Minorsky, V.: *Ḥudūd al-'Ālam*, Translator's Preface, p. vii.

scholars. He was a scientist, historian, naturalist, geologist, mineralogist, astronomer, geographer, encyclopaedist and mathematician and had also studied chronology and medicine. He had a keen geographical sense and his conclusions in that connection deserve high praise. His breadth of views, critical spirit and wide range of knowledge was amazing indeed. His intellectual courage was without parallel in medieval times.

Al-Bīrūnī was born in one of the suburbs of Khawārizm (Khīvā) in 362 A.H./972 A.D.—hence his designation. Even before 407 A.H./1017 A.D, when he was captured by Sulṭān Maḥmūd of Ghaznī on the fall of Khīvā, he was a scholar of high repute and his "Chronology of Ancient Nations" (al-Āthār al-Bāqiyah) belongs to this period (1000 A.D.). He was taken to Ghaznī and later accompanied the Sulṭān on several of his seventeen campaigns in north-western India. There he learned Sanskrit and devoted himself to the study of the Hindu sciences. The result of his study and travels was 'Taḥqīq ma fi'l-Hind' (Kitāb al-Hind—popularly known as Al-Bīrūnī's India) which was published after the death of Sulṭān Maḥmūd, *i.e.*, 421 A H / 1030 A.D. During the time of Sulṭān Mas'ūd he wrote his monumental work 'al-Qānūn al-Mas'ūdi' (Canon Masudicus) and then in the days of his successor, Mawdūd, two notable books, *i.e.*, 'Kitāb al-Tafhīm' and the 'Book on Stones' (Kitāb al-Jamāhīr fi'l-Ma'arifat al-Jawāhar) in which he discussed the sources and characteristics of many precious stones and pearls.[1]

1. Chapter on Pearls in the *Book on Precious Stones*, by Al-Bīrūnī, trans. F. Krenkow, *Islamic Culture*, Vol. XV, No. 4, 1941.

He died after 342 A.H./1050 A.D. and not in 440 A.H./ 1048 A.D. as commonly supposed.[1] Till his very last days, past the age of 80, Al-Bīrūnī kept his intelligence and vast knowledge unimpaired.

By reason of his profound knowledge of facts and the ability to use them, his 'Kitāb al-Hind' may be regarded as one of the most significant productions in the field of regional geography. He also tackled such subjects as mineralogy and geology, the best example of his speculation in the latter field being his explanation of the origin of the plain of Hindustan, which area, according to him, was formerly the bed of a sea and was later filled up by alluvial sediment. The remarkable closeness of this view to the modern conception can best be shown by Al-Bīrūnī's own words. He says, "...one of these plains is India, limited in the south by the above-mentioned Indian Ocean, and on three sides by lofty mountains, the waters of which flow down to it. But if you see the soil of India with your own eyes and meditate on its nature, if you consider the rounded stones found in the earth however deeply you dig, stones that are huge near the mountains and where the rivers have a violent current, stones that are of smaller size at a greater distance from the mountains and where the streams flow more slowly, stones that appear pulverised in the shape of stand where the streams begin to stagnate near their mouths and near the sea—if you consider all this, you can scarcely help thinking that India was once a sea, which by degrees has been filled up by the alluvium

1. Meyerhof: Art. on *Aconite* from Al-Bīrūnī's *Kitāb as-Saydāna* *Islamic Culture*, N. 4, October, 1945, p. 323.

of the streams."[1] Further, his remarks having a bearing on physical geography, which are many, are of a high order. In describing the geography of Asia and Europe, he mentions a continuous chain of mountains from the Himalayas to the Alps. He makes a distinction between a gulf and an estuary; the latter, he says, is a part of the river at its mouth while the former is an extension of the sea penetrating for some distance into the land.[2] Al-Bīrūnī gives a better idea of the inhabitable world than many of his predecessors: he believed in the southern extension of the African continent and the navigability of the ocean in the south. His numerous details about the geography of India include the frontiers of the country, its physical build, the nature of rainfall, the chief itineraries radiating in all directions from Kanoj, the commercial activity of many towns and littoral areas and the ainmal and plant life of the country. From a sociological point of view he discusses the prohibition of beef-eating and explains how, India being a hot country, cow's meat was not easily digestible and also that the land being mostly agricultural the slaughter of cattle was regarded as detrimental to economic life.[3]

He clearly understood the phenomena of tides and explained how the increase and decrease in ebb and flow develop periodically and parallel with the moon's phases and adds that such things are known to the people living near the sea-shores. Describing the situation of Somnath[4] he says that the place owe: its name to

1. Sachau : *Al-Birūni's India*, Vol. I, p. 198.
2. *Ibid.*, p. 210.
3. *Ibid.*, Vol. II, pp 152-53.
4. *Ibid.*, pp. 104-105.

the ebb and flow of water, hence "master of the moon." Each time the moon rises and sets, the water of the ocean rises in flood so as to cover the place, and later, when the moon reaches the meridian of noon and midnight, the water recedes in the ebb. According to him the educated Hindus used to determine the daily phases of the tides by the rising and setting of the moon, the montly phases by the increase and waning of the moon; but he was of the opinion that they did not understand the physical cause of both phenomena.

On the mathematical and the astronomical side of geography, Al-Bīrūnī discusses the antipodes and the roundity of the earth, the determination of its movements, and gives the latitudes and longitudes of numerous places. An interesting yet significant incident in this connection is the report of a Turkish envoy who came to the Court of Sulṭān Maḥmūd at Ghaznī and narrated how beyond the seas towards the South Pole he had observed the sun on the horizon in a manner that the night became non-existent. The Sultān could not believe such a fantastic story and called in Al-Bīrūnī to explain, which the great scholar did to the satisfaction of the monarch.[1]

Finally, an extract from Al-Bīrūnī's writings may be quoted to show not only his understanding of geography but also how he valued the spread of Islam throughout the world in order to promote and assure the collaboration of different nations in the advance-

1. Yāqūt: *Mu'jam al-Udabā'*, Vol. VI, p. 310.

ment of knowledge. He says,[1] "My object therefore is to establish the geographic longitude of a certain city on the earth-globe, that is to say, Ghazna. Hitherto I have been able to show what concerns the longitude, I was not able to establish that properly owing to adverse circumstances But if I were to plead these obstacles as an excuse for such negligence and were to show myself as therefore blameless, I should have portrayed myself as a denier of God's open and secret favours as well as of the benefits of theDispenser of Kindnesses (*i.e* , of the ruler, Maḥmūd of Ghazna) whose hand has brought me unto full prosperity. Something quite different ranks with me as obstacle. I have in mind some other scientific questions, which I pray Almighty God that I may master questions which attract me, and my resolve to deal properly with which will never be shaken even if I were to stand on the brink of an abyss of danger for my soul and for my body I hasten to make this problem my own in order that I may have completed it before the coming of the fearful hour (of death).

"And I say: Most of the data of the 'Geography' (of Ptolemy) concerning the longitude and latitude of points on the earth have really been adopted only on the ground of rumours which had come from far-off districts. In the practical use of such data Ptolemy himself must hit on the right way; but others have only imitated him and it is possible that the latter, moreover, have diverged from the right way. Anyhow, the ground on which these data rest is mere

1. Quoted from *Taḥdid an-Nihāyat al-Amākin*, by Prof. Aḥmad Zakī Validī, *Islamic Culture*, Vol. VIII, 1934, pp. 517-18.

report; indeed those lands were very difficult of access in the past owing to the national divisions (aṭ-Ṭabāyun al-Millī), for national division is the greatest obstacle to travel in countries. We see, for example, some peoples who think--as do the Jews—to come nearer to God through treacherous attacks on folk of other nationalities. Or they take foreigners as slaves, as do the Romans, and that is the lesser evil. Or travellers, because they are foreigners, are turned back, held in every kind of suspicion and they are thus brought to a very unpleasant and dangerous plight.

"But now (the circumstances are quite different), Islam has already penetrated from the eastern countries of the earth to the western; it spreads westward to Spain (Andalus), eastward to the borderland of China and to the middle of India, southward to Abyssinia and the countries of Zanj (*i.e*, South Africa, the Malay Archipelago and Java), northward to the countries of the Turks and Slavs. Thus the different peoples (al-Umam al-Mukhtalifah) are brought together in mutual understanding (*ulfat*), which only God's own Art can bring to pass. And of those (who could be obstructive to cultural relations) only common vagabonds and highway robbers are left. The remaining obstinate unbelievers have become timid and tame; they now respect the followers of Islam and seek peace with them.

"To obtain information concerning places of the earth has now become incomparably easier and safer (than it was before). Now we find a crowd of places, which in the (Ptolemaic) 'Geography' are indicated

as lying to the east of other places, actually situated to the west of the others named, and *vice versa.* The reasons (of such errors) are either confusion of the data as to the distance on which the longitude and latitude were estimated, or that the populations have changed their former places."

Nāṣir-i-Khusrau, the Persian traveller, also belongs to this period and was born in the neighbourhood of Balkh in 1003 A.D. He passed through Palestine on his way to Mecca and was in Jerusalem in 1047 A.D. Earlier he had travelled in India and lived at the Court of Sulṭān Maḥmūd. His travel diary (*Safar-nāmah*) was written in 1045 A.D. in Persian and has been translated by Le Strange. His is the best account of Jerusalem before the Crusades.

Spain also produced several geographers of outstanding merit who travelled widely, observed minutely and wrote exhaustively. Al-Bakri (Abu 'Ubaid 'Abdullah b. 'Abdul 'Azīz) was born at Huedra in 432 A.H./1040 A.D. and worked at Cordova where he died in 487 A.H./1094 A.D. He wrote a 'Geographical Dictionary' (*Mu'jam ma Ista'jam*), and also a book on 'Routes and Kingdoms' (*Al-Masālik wa'l-Mamālik*). Bakrī seems to have studied a wide range of subject-matter before compiling his own work. One of his main sources was the Spanish geographer Muḥammad al-Ṭāriqī, (died 363 A.H./973 A.D.), who had written about North Africa. Another source was the work of Ibrāhīm bin Ya'qūb, a Jewish merchant and slave-dealer, who was a Spaniard and had travelled through Germany and the Slav countries during the reign of

Otto the Great. Bakrī can be regarded as the earliest Hispano-Muslim geographer.

A notable geographer was Muḥammad bin Abu-Bakr az-Zuhrī of Granada, who is one of those few writers who gave to their work the name of geography. He is the author of a 'Book of Geography' (*Kitāb al-Jughrāfiyah*) and lived towards 532 A.H./1137 A.D. It is said that in the time of the Caliph Māmūn, seventy geographers completed a work, of which only a few pages [1] are now preserved in the Bibliotheque Nationale, Paris, No. 2220. This work was utilized by Al-Fazārī and Al-Kumarī and their work in its turn was used and enlarged upon by Az-Zuhrī in his 'Book of Geography.'

Another famous Spanish writer on geography was Al-Māzinī (Abū 'Abdullah Muḥammad b. 'Abdur-Raḥīm al-Māzinī al-Qaisī al-Andalusī), who was born in Granada in 473 A.H./1080 A.D and a contemporary of al-Idrīsī. He came to Egypt in 508 A.H./1114 A.D. and went to Baghdād in 556 A.H./1161 A.D. For a considerable time he studied in Khurāsān and later at Alleppo and died at Damascus in 565 A.H./1169 A.D. One of his works is a geographical description of his journeys, *Tuḥfat al-Albāb wa Nukhbat al-A'jāb*. Another account of his journeys through Spain, Africa, Damascus, Ardbil, the Caspian Coasts, Derband and the land of Khazārs is known as 'Nukhbat al-Adhān fī 'Ajāib al-Buldān'. Two more well-known works are: 'Al-Maghrib 'an Ba'ḍ 'Ajāib al-Buldān' (dealing with Maghrib) and 'Tuḥfat al-Kibār fī Ash'ār al-Bahār'

1. Brockelmann : Supplement, Bd. I.

(dealing with sea voyages), a copy of which is in the Historical Academy, Madrid.

A geographer who seems to be a Spaniard was Al-Munajjim (Isḥāq b. Ḥusain), who is supposed to have worked in the fourth century Hijra between the period 340 A.H./251 A.D. and 454 A.H./1063 A.D. in Morocco. His book deals with many cities (*Kitāb Ākām al-Marjām fī Dhikr al-Madā'in al-Mashhūrah Bikul Makān* (A Geographical Dictionary). The main importance of this work lies in the fact that celebrated writers like Idrīsī and Ibn Khaldūn utilised it.

Abu Muḥammad al-'Abdari of Valencia wrote an account of his journey through North Africa in 688 A.H./1289 A.D. He made the journey both ways in the course of his pilgrimage to Mecca.

Ibn Jubair (Abu'l-Ḥusain Muḥammad Ibn Aḥmad Ibn Jubair al-Kināni) was also of Valencian extraction and was born in 1145 A.D. Among his countrymen he enjoyed a high reputation as a poet. But to the geographer his greatest contribution is the journal which he kept during his first journey to the East in connection with a pilgrimage to Mecca towards the end of the sixth century Hijra. He published this diary soon after his return to Spain under the title *Riḥlat Ibn Jubair* (Travels of Ibn Jubair). It became very popular both in the East and the West, but unfortunately, only one MS[1] has come down to us. His accounts throw interesting light on the geography and cultural and commercial activity of the Muslim

1. Wright: *Travels of Ibn Jubair*, p. 14.

parts of the Mediterranean lands. The writings of Ibn Jubair were utilised by many notable writers and historians after him, like Al-'Abdarī, Al-Balawī, Ibn al-Khaṭīb, Al-Maqrizī, Al-Fāsi, Al-Maqqarī and Ibn Baṭṭūṭa. In his later years he taught at Malaga and then at Fez and Ceuta and died in 1217 A.D.

Ibn Sa'īd al-Maghribī (d. 1274 A.D) wrote a notable geographical work called 'Kitāb Jughrāfiah fi'l-Aqālīm' of which only an extract has been preserved. Though the treatment was on the basis of 'Climates' (Aqālīm), the latitudes and longitudes of many places are added; these facilitate the reconstruction into a map. The writer made use of many new facts including the significant story of Ibn Fāṭima's travels along the West African coasts and the descriptions of tribal settlements in North Africa after the times of Almohades (al-Mu'waḥḥidūn). He travelled in Northern Europe, Armenia and Tartar lands where he also visited the Court of Halagu.

Al-Idrīsi (Abu 'Abdullah Muḥammad b. Muḥammad b. 'Abdullah b. Idrīsī ash-Sharīf) is perhaps the best known Nuslim geographer in the West. By some scholars he is regarded as the greatest geographer and cartographer of the Middle Ages. His travels through Europe and long residence at the Court of the Christian King of Sicily, Roger II, entitled Idrīsi to be taken notice of by Europe much earlier than the others. He came of an 'Alīd family and was born in Ceuta in 493 A.H./ 1099 A.D. and was educated at Cordova. After his long travels through the world of Islam and Europe, he was persuaded by King Roger

to settle down at the Court of Palermo. There, in 548 A H /1154 A D., he wrote a treatise, 'Amusement for him who Desires to Travel Round the World' (*Nuzhat al-Mushtāq fī Ikhtirāq al-Āfāq*) also known as 'Kitāb Rujārī' (Book of Roger). About the same time he also made a celestial sphere and a representation of the known world in the form of a disc, which gives him an outstanding place among the Muslim cartographers. In giving the finishing touches to his work, Idrīsī was in an advantageous position, because Sicily, set almost in the centre of the Mediterranean, was the rendezvous of ships and navigators from the Northern waters, the Atlantic, and the Mediterranean. Idrīsī's knowledge of the Niger above Timbuktu and of the head-waters of the Nile and the Sudan is remarkable for its accuracy. His work is certainly the most notable example of the fusion of ancient and modern geography. A modern geographer [1] has rightly remarked, "In view of its 'modernity' and high intrinsic worth, it is difficult to understand why Idrīsī's work, composed as it was at the chronological and geographical point of contact between the Islamic and Christian civilisations, remained so long unutilised by Christian scholars in Sicily, Italy or other Christian countries until we remember that the primary, we might almost say, the sole interest, of the Latin West in Arabic literature centred in the preparation of calendars, star tables and horoscopes, and the recovery of ancient lore. It was not much concerned in the

1. Kimble: *The Geography of the Middle Ages*, p. 59, He also mentions that the first known translation (into a European language) of Idrīsī's work was published in Rome in 1619 and that this was in a much abridged form and the translator did not even know the author's name,

twelfth century with the descriptive geography of Africa or Asia." One great feature of Idrīsī's work is the absence of unreserved approval of Ptolemy's ideas in the light of his personal knowledge and varied experiences as a widely travelled person.

Al-Mawṣilī (Muḥammad b. 'Alī b. Muḥammad al-Anṣārī) was a writer of a book of travels 'Uyūn al-Akhbār,' giving descriptions of his journey through Syria, Palestine and Egypt, during the period 537-585 A.H./1142-1189 A.D. The book was written in Ceuta and also contains names of scholars of note whom the author had met. Another book of this type was written by Shaikh al-Ḥarawī dealing with the most frequently visited places of pilgrimage in the eastern part of the Islamic world (*Ishārāt 'Alī Ma'rifat al-Ziārāt*). Hied in 611 A.H./1214 A.D.

Yāqūt Ḥamawī (Ibn 'Abdullah al-Rūmī) came of Greek parentage and was born in 574 A.H / 1179 A.D. and died at Ḥalab in 1229 A.D. While yet a boy he was captured and later purchased by a Baghdād merchant who came from Ḥamā, hence the designation 'Ḥamawī'. Yāqūt is one of the most celebrated of Muslim geographers and his work is of tremendous importance as it gives us a picture of the world of Islam just before the destruction of its culture and prosperity at the hands of the Mongols. Yāqūt lived a truly adventurous life. First he undertook commercial travels for his master, but after his third journey in 590 A.H./1194 A.D. to the island of Krish (in the Persian Gulf), he left his benefactor. He became a pupil of 'Ukbarī and after acquiring some

learning became a bookseller and decided to write himself. In 610 A.H./1213 A.D. he again went on a journey, first to Tabriz, then to Mūṣul, Syria and Egypt. Two years later he started from Damascus on his eastern journey and came to Nīshāpūr in the following year and at Marw he studied many valuable works. Thus he equipped himself to write, but while at Balkh he heard of the first onrush of the Tartar hordes and quickly repaired to Mūṣul in 1220 A.D. His great 'Geographical Dictionary' (*Mu'jam al-Buldān*) was finished on the 13th March, 1224, and he died five years later at Alleppo. Yāqūt was a self-made man of wide learning and varied experiences and his writings reveal enormous industry. *Mu'jam al-Buldān* is an outstanding work in the Arabic literature.

Mu'jam al-Buldān described in alphabetical order every town and place of which the author could obtain any information. The book deals with historical, ethnographical and physical matters and carries an introduction pertaining to the size of the earth, climatic zones and physical, mathematical and political geography in general. Besides, the book also gives detailed accounts of the Islamic lands from Spain to Transoxiana and India, as seen in the thirteenth century A.D. one Ṣafī al-Dīn (1300 A.D.) later abridged the text and made a few additions and entitled it as 'Marāsid al-Iṭṭilā' '.[1] Yāqūt's other monumental work 'Mu'jam al-Udabā' ' (Dictionary of Learned Men) also provides useful geographical information, besides literary notices. He made a thorough study of the out-

1. Le Strange. *Palestine under Muslims*, p. 9.

standing geographical works before his time and in fact references to several compilations no longer available are only found in his books. He displayed the critical method of a modern geographer in his criticism of Ptolemy's reference to places and towns in Arabia[1] when he mentions that he failed to identify many places given in the works of Ptolemy, since they no longer existed.

Al-Qazwīnī (Zakariyā b. Muḥammad b. Maḥmūd Abū Yaḥyā) was born at Qazwīn in Jibal (N. Iran) in 600 A.H./1203 A.D. and belonged to a pure Arab family. In the reign of the last Abbasid Caliph Mu'taṣim, he was living in Iraq and filled the office of the Qāḍī of Wāsiṭ and Hilla. He died in 682 A.H./1283 A.D. He left two works[2] of approximately the same size, one 'Cosmography' and another 'Geography'. His 'Cosmography' (*'Ajāib al-Mukhlūqāt wa Gharāib al-Mawjudāt*) remained popular not only for centuries during the Middle Ages but down to the modern times. It consists of two parts, (1) dealing with heavenly things, (2) terrestrial. It also contains a great deal that is purely geographical, as it describes the more important mountains, islands, seas, rivers and springs. The 'geography' exists in two editions with different titles, the older one called ' 'Ajāib al-Buldān and the latter 'Āthār al-Bilād' (a Historical Geography) written in 1250 A.D. Here Qazwīnī gives a description of the earth following the Ptolemaic division into seven climes (Iqlīm). The book is full of historical and biographical material. The text was accompanied by illus-

1. M. Sulaimān Nadvī : *Arḍ-ul-Qur'ān*, Vol. I, p. 71.
2 *Encyclopaedia of Islam*, Vol. II, pp. 841-44.

trations and pictures. No less than fifty authors are quoted by the writer in his 'Geography'. For the portions dealing with Spain, prominent Muslim geographers of that country, *i.e.*, Al-Gharnāṭī, Al-Udhrī and Al-Andalusī are mentioned and for his remarkable information on French and German towns, Qazwīnī depends on personal contact with the Spaniard Ibrāhīm al-Ṭurṭushī (d. 477 A.H./1085 A.D.). Other authors consulted by him include Al-Jāhiz, Ibn Faḍlān, Mi'sar al-Muhilhil and Al-Multānī Abu'l-Rabī' Sulaimān(who had travelled in the interior of Africa).

Abu'l-Fidā (Ismā'īl b. 'Alī b. Muḥmūd b. Shahanshāh b Ayyūb 'Imādu'd Dīn al-Ayyūbī) belonged to the ruling house of Ḥamat, a branch of the Ayyūbids of Egypt, and was born in Damascus (672 A.H./1273 A.D.) where his father Al-Malik al-Afḍal, brother of the Amīr of Ḥamat, Al-Malik al-Manṣūr, had fled before the Mongols. His works display extensive knowledge and desirable balance in the selection of information and have thus gained wide recognition in Europe as typical of the later Muslim School of Geography. His main geographical work[1] is 'Taqwīm al-Buldān.'

Ḥamdullah Mustawfī's work 'Nuzhat al-Qulūb' is of special significance, because it was written in Persian and pictured the world of Islam in the East, after the tornado of the Tartar destruction had almost spent its fury. He wrote the book in 1340 A.D. in the days of Sulṭān Abu Sa'īd the Ilkhān, the great grandson of

1. The French Orientalist Reinaud in his useful commentary on Muslim geography, *Introduction General Geographie d'Aboulfida* and in the edition on *Taqwīm al-Buldān* throws interesting light on his work.

Hulāgū. He was the State Accountant (Mustawfi) in the service of the Sulṭān and by virtue of his office had access to revenue lists and other documents which equipped him with information not commonly available. 'Nuzhat al-Qulūb' gives detailed accounts of the varied geographical aspects, physical and human, of all parts of the Islamic world. Iran and Central Asia receive special treatment. There is a comprehensive account of the seven seas and the islands therein. Japan, Java and Sumatra are mentioned among others.[1] A description of equatorial trees and animals is also given and the tropical luxuriance of these regions is particularly emphasised.[2] Ḥamdullah also speaks of the change in the course of the Oxus in his own times. which diverted the river from the Caspian to the Aral Sea. Hot springs and the Baku oil wells are mentioned. The chief authorities consulted by Ḥamdullah seem to be Ibn Khurdādhbih, Qazwīnī and Yāqūt. Though he cannot be credited with much originality yet in many of his accounts of towns and descriptions of provinces, he has added something of his own as a result of personal observation and carefully gathered information. He also wrote a historical work called 'Tārīkh-i-Guzīdah' (TheSelect History) which, besides being of considerable value for Mongol times, contains in many places geographical information of much importance.

Another geographer who shows much originality was Al-Damishqī (Abu 'Abdullah Muḥammad b. Abī Ṭālib al-Anṣārī al-Ṣūfī Shams al-Dīn) who died as

1. *Nuzhat al-Qulūb*, Chap. XX.
2. *Ibid.*, pp. 221-26.

Imām of Rabwa in Syria in 727 A H./1327 A.D. He is said to have written his geographical work 'Nukhbat al-Dahar fī 'Ajāib al-Barr wa'l-Bahr' (Cosmography) about 1325 A D. Among his sources may be mentioned Mas'ūdī, Ibn Hawqal and Yāqūt. In addition, he gives names of many new places which remain unmentioned by his predecessors. For Arab's knowledge of South India[1] along the Malabar and Coromandal coasts, he is an important authority and gives the largest list of place names. On the whole, Damishqī was an original and painstaking writer and collected information carefully from various sources.

At this late period came a contribution of tremendous importance which has not received enough attention in the West; this was the dictated account of his extensive travels by Ibn Baṭṭūṭa. He actually travelled much more than Marco Polo. Not many details are known about Ibn Baṭṭūṭa's life, apart from his accounts of his travels. He was born at Tangier on the 24th February, 1304, and died in 1369. He left Tangier on Thursday, 2nd Rajab 725 A.H. (14th June, 1325 A.D.), when he was twenty-two years of age, and his entire travels lasted for about thirty years, after which he finally returned to Fās (Fez) in Morocco at the Court of Sulṭān Abū 'Inān and dictated accounts of his journeys to Ibn Juzayy. These are known as the famous Travels (Rihla) of Ibn Baṭṭūṭa.

Abū 'Abdullah Muhammad Ibn Baṭṭūṭa, also known as Shams ad-Dīn, was in fact the only medieval

1. Nainar: *Arab's Knowledge of South India*, p. 19.

traveller who is known to have visited the lands of every Muslim ruler of his time. He also travelled in Ceylon, China and Byzantium and South Russia. The mere extent of his travels is estimated by Yule at not less than 75,000 miles, without allowing for deviations, a figure which is not likely to have been surpassed before the age of steam.[1] In the course of his first journey, he travelled through Algiers, Tunis, Egypt, Palestine, and Syria to Mecca. After visiting Iraq, Shiraz and Mesopotamia he once more returned to perform the Ḥajj at Mecca and remained there for three years. Then travelling to Jeddah he went to Yemen by sea, visited Aden and set sail for Mombasa (E. Africa); after going up to Kulwa he came back to 'Umān and repeated his pilgrimage to Mecca in 1332 *via* Hormuz, Sīrāf, Baḥrain and Yamāmā. Afterwards he set out with the purpose of going to India, but on reaching Jeddah he changed his mind and revisited Cairo, Palestine and Syria, thereafter arriving at Aleya (Asia Minor) by sea and travelled across Anatolia to Sinope, whence he crossed the Black Sea to Kerch in the Crimea and, after long wanderings over the Kuban steppes to the mouth of the Volga, accompanied a Greek Princess (Khātūn Baylun) to Constantinople through Southern Ukraine. On his return from the Byzantine capital, he came back to Astrakhan and thence entered Khurāsān through Khwārizm (Khīva) and having visited all the important cities like Bukhāra, Balkh, Herāt, Ṭūs, Mashhad and Nīshāpūr, he crossed the Hindu Kush mountains by the 13,000 ft. Khawak pass into Afghānistān and passing through

1. Gibb: *Ibn Baṭṭūṭa*, p. 9 (Introduction).

Ghaznī and Kābul entered India. After visiting Lāhirī (near modern Karachi), Sukkur, Multan, Sirsa, and Hānsī, he reached Delhi. For several years Ibn Baṭṭūṭa enjoyed the patronage of Sulṭān Muḥammad Tughlaq, and was later sent as an embassy to China. Passing through Central India and Malwa he took ship from Kambay for Goā; and after visiting many thriving ports along the Malabar coast he reached the Maldive Islands, from which he crossed to Ceylon and climbed the Adam's Peak. Continuing his journey, he landed on the Ma'bar (Coromandal) coast and once more returning to the Maldives he finally set sail for Bengal and visited Kāmrūp, Sylhet and Sonārgāon (near Dacca). Sailing along the Arakān coast he came to Sumatra and later landed at Canton *via* Malaya and Cambodia. In China he travelled northward to Peking through Hangchow. Retracing his steps he returned to Calicut and taking ship came to Dhafari and Muscat, and passing through Fārs, 'Irāq, Syria, Palestine and Egypt made his seventh and last pilgrimage to Mecca in November 1348 A.D. Returning homeward he came to Tunis through Egypt and Cyrenaica and went to Sardinia by ship, later reaching Fez. But Ibn Baṭṭūṭa's 'wander lust' was not quenched until he had visited Muslim Spain and the lands of the Niger across the Sahara.

Historically, Ibn Baṭṭūṭa's travels came at a period when the majority of the Tartar conquerors had been converted to Islam, and as a consequence the political conditions in the Islamic lands were relatively stable. But what interests a modern geographer is neither his account of the wealth, generosity, or eccentricities of

Sulṭān Muḥammad Tughlaq, the piety of noble-minded Shaikhs, nor the number of the lovely slave-girls he possessed, but descriptions of varying natural environment, products of far-off lands, articles of export, metropolises, ports and sea-routes, and the great traveller's understanding of their significance. It is indeed remarkable that the errors are comparatively few, considering the enormous number of persons and places mentioned by him. Doubts have been expressed regarding the genuineness of two of his journeys, namely to Bulghar lands (Kuban area and lower Volga) and to China. But, perhaps the best argument for belief is found in the depth of his keen geographical observations. His description of the Kuban steppes with horses more than the number of sheep in Morocco, and their herding by keepers with the help of lassong,[1] gives a true picture. Speaking of the land to the north beyond the left bank of the Volga, he refers to its intense winter cold, the thick mantle of snow covering the ground, the use of dog-drawn sledges as the only means of communication, and the skins of sable, minever and ermine used in trade.[2] In the account of his return journey from Constantinople through South Ukraine, he once more speaks of the intense cold, saying that he had to wear three fur coats and two pairs of trousers, and adding that while he was making his ablutions with hot water close to a fire, the water ran down his beard and froze. In connection with the Chinese travels, he speaks of the use of coal when he says, "They make fires with stones which burn like

1. Gibb: *Ibn Baṭṭūṭa*, p. 115. 2. *Ibid.*, pp. 150-51.

charcoal, and when they are burned to ashes, they knead these with water, dry them in the sun, and use them for cooking again until they are entirely consumed."[1] Further, he remarks that China was the best cultivated country in the world and that there was not a spot in the whole extent of it that was not brought under cultivation. If Marco Polo can refer to the city of Hangchow as being within a hundred-mile compass and possessing twelve thousand bridges of stone, then Ibn Baṭṭuṭa's remark that it took three days to traverse it does not savour of too much of an exaggeration.

He gives an excellent description of the numerous small coral islands in the Maldive group enclosing atolls, and the low level surfaces of these islands. He points out the immense utility of the coconut-palm, and the multifarious uses of all of its parts, recognises cowries to be the shells of animals, and comments on the abundance of fish and the rice cultivation of these coral islands and tropical shores. He also mentions the peculiar dress, manners, and customs of the people.[2] Similarly along the East African coast he describes the production of betelnuts, bananas, coconut, other palms and the import of rice from India.

Ibn Baṭṭūṭa's sea voyages and references to shipping reveal that the Muslims completely dominated the maritime activity of the Red Sea, the Arabian Sea, the Indian Ocean, and the Chinese waters. Also it is seen that though the Christian traders were subject to certain restriction, most of the economic negotiations

1. Gibb : *Ibn Baṭṭūṭa*, p. 169.
2. *Ibid.*, pp. 243-44.

were transacted on the basis of equality and mutaul respect. People of either religion were taken as passengers on ships without animosity, as Ibn Baṭṭūṭa himself travelled on Genoese and Catalan ships.

Ḥāfiẓ Abrū (Shihāb al-Dīn 'Abdullah b. Luṭfullah al-Rashīd al-Khwafī) was a friend and companion of Tīmūr. He is remembered as a noted Persian historian and geographer who died in 833 A.H./1429 A.D. According to Barthold he was commissioned by Shāhrukh about 817 A.H. 1414-15 A.D. to write a geographical compendium based upon the older Arabic works, probably Balkhī and Iṣṭakhrī [1] The work is divided into two volumes, having a cosmographical introduction in the first part. Later follow descriptions of various lands from the West to East (Maghrib to Kirmān). The portions on the regional geography of Khūrāsān and Ma-wra al-Nahr (Transoxiana), unfortunately, remain untraced. Though as a compiler Ḥāfiẓ Abrū incorporated much material from works which have since been lost, it is claimed by a competent critic like Barthold that for the events and conditions of the times the pertinent sections of the work remain an authority of the first rank. The writer was no arm-chair geographer as he had himself widely travelled and gained information from personal observation. The work is entitled 'Zubdat al-Tawārīkh.'

'Abdul Razzāq (Kamāl al-Din b. Isḥāq al-Samarqandī) was born in Herāt 816 A.H./1413 A.D. and died there in 887 A.H./1482 A.D. He figures prominently

1. *Encyclopaedia of Islam*, Vol. II, p. 213.

as a Persian historian who has had the benefit of a diplomatic career. He went to India as an ambassador, returning in 1444 A.D. after a three-year stay in the East. On his return he wrote his 'Maṭla' al-Sa'dain wa Majma' al-Baḥrain.' Parts of this work are based on Ḥāfiẓ Abrū's writings but all in all, it can be said to be one of the most important and original sources of information for geographical knowledge during his times. Among the later writers may be mentioned the great scholar produced by India, Abu'l-Faḍl 'Allāmī (born in Agra 958 A.H./1551 A.D.), one of the bright lights of the Mughal age in the time of Akbar the great. His 'Āīn-i-Akbarī' (in Persian) was written to incorporate many sided contemporary knowledge as viewed by the writer. The geographical references include a description on traditional lines based upon 'climates' and a general survey of the Indian geographical scene[1] with detailed accounts of the Mughal Ṣūbahs (provinces). It remains an indispensable source for reconstructing the historico-geographical picture of the hey day of the Mughal times. Apart from its philosophical and general academic merits, a parallel for which is hard to find in the contemporary West, the work has been favourably compared for its patience and industry to modern productions in the field of statistical science and tabulation of resources.[2]

Amīn Aḥmad Razī was a native of Ray and came from a well-known family of men of letters. He was a first cousin of Mirzā Ghiāth Beg, father of Nūr Jahān

1. *Āin-i-Akbari* (tr. Jarret), Vol. III, pp. 7-9. Also *Animal and Plant Life*, pp. 114-22.

2. *Ibid*, Translator's Preface, p. 1.

who later became the Vizier of Akbar with the title of I'timād ad-Dawla. There is evidence of Razī having visited India during Akbar's time as he speaks of the great Emperor in the present tense. He wrote a detailed account of India from the earliest times to his day and added a special chapter on the history of the Deccan. His geographical writings consist of the book with the title of *Haft Iqlīm* (Seven Climates) which deserve a high praise. It is a topographical and biographical encyclopaedia.[1] Information is presented on the basis of 'climates.' Under each country and town is found an account of the place, its history, wonders and curiosities and chief products. It is regarded by some scholars as the best and the first encyclopaedia in Persian to be arranged on a geographical plan. The work later became very popular. For the geographical portion among his sources, Razī mentions Khurdādhbih, Balkhī, Yāqūt and Mustawfī. The work was completed in 1002 A.H./1593 A.D.

With the rise of the Turks and later their political predominance over large parts of Western Asia and South-eastern Europe, Turkey became the source of Muslim geographical writing onward from the middle of the fifteenth century A.D. This literature has many aspects, *e.g.*, cosmographical, descriptive, travel and oceanographic. An interesting feature is the availability of European views on geographical matters and their fusion with earlier Arabic geography and contemporary eastern knowledge which was attempted by Muslim geographers at this period. State patron-

1. *Haft Iqlim*, Preface, p. iv.

age is indicated in the interest shown by the early Ottoman rulers who encouraged these geographical activities, *i.e.*, manuscripts of earlier geographers were collected, copies made and maps prepared. This explains the richness of the public libraries of Constantinople in this respect.[1]

Apart from the translations of earlier cosmographical works and descriptive writings (including, Qazwīnī, Abu'l-Fidā, Ibn al-Wardī, Al-Iṣṭakhrī and Ptolemy's Geography, etc.), there were several independent efforts to sum up the geographical knowledge of the time. Among the treatises on geography may be mentioned Muḥammad b. 'Umar b. Bāyazīd al-'Āshiq's 'Manāẓir al-'Ālam' (Description of the World) which was written at Damascus in 15)8 A.D. The work was based upon the authors's personal journeys as well as information derived from older writings and contemporary knowledge. Next came the 'Geographical Encyclopaedia' (Kashf aẓ-Ẓunūn 'an Asāmī al-Kutub wal-Funūn) of Ḥājī Khalīfah (Muṣṭafā b. 'Abdullah) also known as Kiatib Chelebī, over which the author spent 20 years in collecting material. He was born in Constantinople in 1017 A.H./1608 A.D. and died there in 1067 A.H./1657 A.D. The work draws not only on older works but also some later contributions such as those of Muḥammad 'Āshiq, Admiral Sidī 'Alī and Pīrī Raīs. It also takes note of European works, including Mercator's 'Atlas.'[2] Barthold[3] considers it the first attempt to compare the data of European geographical

1. Kramer's *Encyclopaedia of Islam*, Sup. No. 2, p. 71.
2. *Ibid.*
3. Barthold : *Mussalman Culture*, p. 140.

literature with that of the Muslims. In the category of travel literature may be pointed out 'Mir'at al-Mamālik', the account of his journey from India to Constantinople by Sidī 'Alī and Auliyā Chelebī's travel book (Tārīkh-i-Saiyāh). The latter work was based largely upon the personal travels of the author between 1640—1672 A.D. throughout the Ottoman Empire, Europe and Persia. It is devoid of influence of European geographical ideas and for the completeness and many-sidedness of information is of a high order. The cartographic attempts of Pīrī Raīs including the copy which he made of Columbus' last map and Sidī 'Alī's 'Oceanography' (Al-Muḥīṭ) remain outstanding among the contemporary works on geographical matters. The tradition of Turkish geographic-*cum*-descriptive and regional writing was continued down to the close of the last century.

THE ARAB NAMES IN THE MEDITERRANEAN LANDS IN MIDDLE AGES



Facing p. 62. "MUSLIM CONTRIBUTION TO GEOGRAPHY"

CHAPTER III

AL-BĪRŪNĪ'S GEOGRAPHY OF INDIA[1]
EXAMPLE OF EXCELLENCE OF MUSLIM GEOGRAPHY

AL-BĪRŪNĪ is generally remembered as a great historian who wrote at a vital period in Indian history. But what interests a geographer most is the extent of geographical information and his amazing grasp of the fundamental influence of geographical factors in human affairs. In his great book *Kitābul-Hind* (Al-Bīrūnī's India) he gives ample proof of his understanding of geographical influences, in his discussions relating to various aspects of the geography of the country. He was not an arm-chair intellectual. No sooner did he arrive in India than he devoted himself to the study of the languages of the country, particularly Sanskrit and therefore his approach to numerous sociological problems had the sound background of the wisdom of native observations as well as personal study. His method, accordingly, was truly critical.

The following is an attempt to reconstruct the geographical picture of India from his multifarious observations found in several parts of his great book on India.[2]

1. Reproduced with some alterations from the *Calcutta Geographical Review*, Vol. V, March, 1943, and Vol. V, December, 1943, from a paper by the present writer.

2. The text of *Al-Birūni's India* translated by Edward Sachau (Kegan Paul, London, 1914), has been used and the extracts taken are from the same source. Help has also been taken from the excellent annotations at the end of the translation.

PHYSICAL SETTINGS—FRONTIERS, PHYSICAL BUILD, RIVERS, PLAINS, MOUNTAINS, ETC.

Speaking of the ocean south-east of the inhabitable world he says,[1] "This sea is mostly called from some island in it or from the coast which borders it . . . the sea which is bordered by the continent of India is therefore called the Indian Ocean." The coast of India begins with Tīz, the capital of Makrān and extends in a south-eastern direction to Al-Daibal (Daibal)[2] and onwards to Kach and Somnāth, Gulf of Cambay, western coast by Thana and then follows a great bay in which lies Singaldīb (the Island Sarandīp—Ceylon).[3] Along this southern coast are mentioned a number of places including Baroi (Baroda), Kar.bāyat (Cambay), Bihroj (Broach), Tānā (Thana), Ramsher (Rameshvaram); Panjayavar (Tanjore), and Setubandha (Adam's Bridge), etc. The islands of the Indian Ocean mentioned are: "The Zabaj called by the Hindus Suvarnadvipa, *i.e.*, the gold islands. The western islands in this ocean are those of Zanj (Negroes) and those in the middle are the Islands Ramm and the Diva Islands (Maldives and Lacadives) to which also belong the Qumair Islands."[4] In addition detailed references are made to Ceylon, which according to the author was

1. Vol. I, p. 197.

2. Identified with the site of modern Karachi by Elliot (Vol. I, pp. 374-78). According to Cunningham & Crow Daibul may be located between Krachi and Thatta (see pp. 341-43). Ibn Khurdādhbih, Mas'ūdī and Ibn Baṭṭūṭa place it a few miles up the Indus Indeed the repeated changes in the course of the Indus now make it difficult to be exact. Though it is mentioned even in Sasanian times and the Arabs captured it in 93 A.H /712 A.D. (*Encyclopaedia of Islam*, Vol. I, p. 896).

3. References in brackets are modern versions and have been added to facilitate identification.

4. Vol. I, p. 210.

known as the castle of the demons and he goes on to relate the story of Rama and Sita's exile.

Along the northern frontiers of India, many details of Kashmīr[1] are given and a description is provided of the tortuous course of the Indus. Al-Bīrūnī speaks here of high mountains, their peaks and of everlasting snow. 'In the west, there lies the country of the Afghan tribes stretching up to the Sindh valley.'[2] As to the chain of mountains traversing the heart of Asia, north and north-west of India, Al-Bīrūnī had an almost correct idea of its vastness and extent. 'As to the orographic configuration of the inhabitable world, imagine a range of towering mountains like the vertebrae of a spine stretching through the middle latitude of the earth and in longitude from east to west, passing through China, Tibet, the country of Turks, Kābul, Badakhshān, Torkhāristān, Bāmiyān, Al-Ghor, Khurāsān, Media, Ādharbaijān, the Roman Empire, the country of the Franks and of the Jalalika (Gallicians).[3] The mountains from the northern boundaries of India and they are the snowy Himavant (Himalayas) part of the drainage of which is directed towards Central Asia and part towards India. The northern and eastern mountains of India in reality form one and the same chain, extending towards the east and then turning towards the south, until they reach the great ocean (Indian Ocean) where parts of it penetrate into the sea at the place called the Dyke of Rama.[4] Of course,

1. Which will be dealt with later on.
2. Vol I, p. 208.
3. *Ibid.*, p. 197.
4. Here apparently Al-Bīrūnī confusod the Arakan ranges with the Southern tip of peninsular India, close to the Adam's Bridge (a series of sandy islands).

these mountains differ very much in cold and heat.'[1]

Quoting Bhuvanakosa,[2] Al-Bīrūnī says that the inhabitable world stretches from the Himavant (Himalayas) towards the south and is called Bhāratvarsha. North of the Himalayas lay the traditional Mount Meru, towering above the world and unapproachable in its majesty.

The Plain.—South of the Himalayas is mentioned the vast plain of India and in this connection the most amazing fact is that Al-Bīrūnī's discussion as to its possible origin is highly scientific—'one of those plains in Ind a, limited in the south by the abovementioned Indian Ocean and on all three sides by the lofty mountains, the waters of which flow down to it. But if you have seen the soil of India with your own eyes and meditate on its nature—if you consider the rounded stones found in the earth, however deeply you dig, stones that are large near the mountains and where the rivers have a violent current; stones that are of smaller size at greater distance from the mountains and where streams flow more slowly; stones that appear pulverised in the shape of sand where the streams begin to stagnate near their mouths and near the sea—if you consider all this you could scarcely help thinking that India had once been a sea which by degrees has been filled up by the alluvium of the streams.'[3]

Rivers.—The rivers of India are said to come

1. Vol. I, p. 258.
2. An ancient Hindu geographical work.
3. Vol. I, p. 198.

either from the cold mountains in the north or from the eastern mountains. Al-Bīrūnī devotes considerable space to a discussion of the rivers of India. Their sources and courses are mentioned in detail[1] and reference is also made to various Hindu sources from which he had gathered information regarding their names and areas they traversed. First, he mentions a large number of rivers rising in the various knots of mountains as mentioned in the Vayu-Purana. They include such names as Godavari, Bhimarathi (Bhima), Krishna (Kistna), Tungabhadra, Kaveri, Sona (Son), Narmada (Nerbudda), Tapi (Tapti), Durga, Nanda, etc. After this another table is given with names of many more rivers such as Sarayu (Sarju), Gomati, Kansiki (Kosi), Gandaki (Gandak) and Karatoya. The river Sindh (Indus) rises in the mountains of Unang in the territory of the Turks, which can be reached *via* Kashmīr and Gilgit. He also calls it the river Vaihand. The river Biyatta, known as Jailam (Jhelum) from the city of this name on its western banks and the river Candarāha (Chenab) join each other nearly 50 miles above Jahravar and pass along west of Multan. The river Biyah (Bias) flows east of Multan and afterwards joins the Biyatta and Candarāha. The Ivara (Ravi) is joined by the Kaj which rises in Nagarkot in the mountains of Bhatul. And thereupon flows the fifth river of the Punjab Shatladar (Sutlej).

He goes on to say that after these five rivers have joined below Multan at a place called Pancanada (Panchanad), *i.e.*, the meeting-place of five rivers, they

1. See Vol. I, Chap. XXV.

form an enormous water-course. In flood time it swells to such a degree as to cover a spate nearly 10 'farsakhs'—about 37 miles (obviously an exaggeration) and to rise above the trees of the plains, so that afterwards the rubbish carried by the floods is found in their highest branches like bird's nests. Further, it is added, that the Muslims called the river, after it had passed the Sindhi city Aror, as a united stream, the river of Mihrān. And that flowing straight on, it became broader and broader, gaining in purity of water, enclosing in its course places like islands, until it reached Al-Manṣūrah situated between several of its arms and flowed into the ocean at two places near the city of Lohārānī (near Karachi) and more eastwards in the province of Kach at a place called Sindhu-Sagara (Sind-Sagar).[1]

The river Sarasti (Saraswati) falls into the sea at the distance of a bowshot east of Somnāth. In connection with the Ganges and its numerous tributaries, Al-Bīrūnī mentions the Hindu belief that originally the river flowed in Paradise and quoting the 'Matsaya Purana,' the writer goes on to say, 'after the Ganges had settled on earth it divided itself into seven armes, the middle of which is the main stream known as the Ganges.'[2] The river Jaun (Jamna) joins the Ganges below Kanoj, which lies west of it. The united stream falls into the great ocean near Ganga-Sagara. In another place[3] it is said that at the junction of the two rivers, Yamuna (Jamna) and Ganga (Ganges) there is

1. Vol I. p. 262.
2. *Ibid.*, p. 261.
3. Vol II. p. 170.

a great tree called Prayaga, a tree of the species 'Vata' (?).

Between the mouths of Sarasti and the Ganges is mentioned the mouth of the river Narmada, which descends from the eastern mountains, takes its course in a south-western direction and falls into the sea near the town of Bahroj (Broach) nearly 60 'yojana' (nearly 120 miles)[1] east of Somnath.

Climate and Seasons.—Speaking of the seasons,[2] he says, that uneducated people used two divisions or year-halves, because the matter of the wo solstices is clear to them from the observation of their senses. Further, the ecliptic is divided into two halves, according to its declination from the equator and this division was a more scientific one, less known to the people at large than the former, because according to the writer, it rested on calculation. Each half was called 'Kula'. That which had northern declination was called 'Uttra-Kula' and the one with the southern declination was 'Daksha-Kula'. By both these divisions the ecliptic was divided into four parts, and the period during which the sun traverses them were called the seasons of the year—spring, summer, autumn and winter. However, Al-Bīrūnī adds that the Hindus did not divide the year into four, but six parts and called these 'ritu', each 'ritu' comprehended two solar months. In the regions of Somnath people divided the year into three parts, each consisting of four months, the first being

1. According to Al-Bīrūnī one 'yojana' was equal to 8 Arabic miles or = 32,000 yards and one 'Kroh' = ½ 'yojana,' (Vol. I, p. 107).

2. Vol. I, p. 357.

'Varshakal' (rainy season) beginning with the month 'Ashadha' (Ashar, *i.e.*, June-July) the second 'Sitakala' (winter) and the third 'Ushnakalā' (Grishma, *i.e.*, summer).

Following months are mentioned: Chaitra, Vaishakha, Jyastha, Ashadha, Sravana, Bhadrapada, Asvayuja, Karttika, Margashirsha, Pausha, Magha, and Phalgun.

Rainfall.— With regard to the peculiarities of rainfall of India[1] and the apparent eccentricities of the monsoon a characteristic description is provided.

'India has the tropical rains in summer, the period being called "Varshakala." These rains are more copious and last the longer the more northward the situation of a province of India and the less it is intersected by ranges of mountains.[2] The people of Multan used to tell me that they have no "Varshakala," but the more northern provinces nearer the mountains have the "Varshakala." In Bhatal and Indravedi (Antervedi—the old name of the Lower Doab of the Ganges and Jamna, extending roughly from Etawah to Allahabad) it begins with the month of Ashadha (June-July) and it rains continually for four months as though water-buckets were poured out. In provinces still

1. Vol. I, p 211.

2. A very keen observation.—Actually in the north there is a dissimution of rainfall from the monsoon as we proceed westward and southward (away from the Himalayas). The reference to the intersection of mountain ranges conveys the idea that Al-Bīrūnī understood the effect of a 'rain shadow.'

farther northward, round the mountains of Kashmīr, up to the peak of Judari between Dunpur and Barshawar, copious rainfalls during the two and a half months beginning with the month of Sravana. However, on the other side of the peak there is no rainfall for the clouds in the north are very heavy and do not rise much above the surface, when they reach the mountains, they strike against them and the clouds are passed like olives or grapes, in consequence of which the rain pours down and the clouds never pass beyond the mountains. Therefore Kashmīr has no "Varshakala," but continual snowfall during two and a half months, beginning with Magha (January-February) and shortly after the middle of Chaitra (March-April) continual rains set in for a few days, melting the snow and clearing the earth. This rule seldom has an exception; however, a certain amount of extraordinary meteorological occurrences is peculiar to every province of India.'

Animals.—References to the animals of the country are very brief. Facts and fancy are found curiously mixed up in the accounts relating to the subject and the discussion is introduced as a mere digression.[1] First he describes an animal named 'Sharava', living in the plains of Kunkan (Konkan)—called 'Danak.' This creature is said to have been bigger than a 'gandar' (rhinoceros) and a terror to other animals. Of the 'gandar' itself, it is said that it existed in large numbers in India, more particularly near the Ganges river. A description of the animal is given and it is added that

1. Vol. I, pp. 203-5.

the author witnessed how an elephant coming across a young 'gandar' was attacked by it. The animal wounded the forefoot of the elephant with its horn and threw it down on its face.

Then Al-Bīrūnī mentions that there were crocodiles in the rivers of India as in the Nile, a fact which he says, led the simple Al-Jāhiz[1] in his ignorance of the courses of the rivers and the shape and form of the ocean to think that the river of Mihrān (Indus) was a branch of the Nile. Besides there were other marvellous animals in the rivers of India of the crocodile species, 'Makara', curious kinds of fishes and an animal like a leather-bag which approaches the ships and plays in swimming. It is called 'burlu' (porpoise). In the rivers of southern India there was an animal called by various names 'graha', 'jalatantu', and 'tendua'.

Communications and Itineraries.—Early in the eleventh century India lacked many well-developed lines of communications. The routes and their prevalent use for normal traffic was largely determined by considerations of geography (relief, climate and vegetation, etc.) military needs and pilgrimages. Al-Bīrūnī came to India at a very eventful period in her history when the main tide of the series of Muslim invasions under Sulṭān Maḥmūd had just subsided. These invasions had largely followed directions determined by the politico-geographical considerations. Therefore, in addition to the already frequented routes many new

1. Was one of the leading intellectuals and rationalist of Basrah in the middle of the ninth century A. D. One of his most famous compilations was the '*Book of Animals*.' He was also an anthropologist of repute.

itineraries had come into being. In this connection the problem of reckoning distances is an interesting one. Al-Bīrūnī gives distances in 'farsakhs' though regarding the exact measure of which he does not give accurate information. After a comparative study of his reference to the Hindu 'yojana' and the Arabic miles, Sachau has established the relationship that one 'farsakh' is equal to about three miles.

Al-Bīrūnī did not consider the Hindu methods of reckoning distances accurate and suggested that it was with the greatest exertion and caution that the statements of Hindu writers could be corrected. But keeping an open mind on the problem, he added, 'However, we could not make up our mind to suppress that which we know on account of that which we do not know, we ask the readers' pardon where there is anything wrong . . .

Sixteen itineraries are given which seem to have been communicated to him by the military and civil officers of the Sulṭān who had marched on some of these roads with huge armies, *e.g.*, to Kanoj and to Somnath. In addition, the information was also probably derived from merchants, sailors, pilgrims and travellers both Hindu and Muslim. The starting points of these itineraries were Kanoj, Mahura (Muttra), Anhilwara (Pattan), Dhar in Malwa, B ri (the temporary Hindu capital east of Kanoj), and Bazana.

These itineraries were : (1) From Kanoj to Allahabad and thence towards the eastern coas. of India as far as Kanci (Conjeveram) and farther s uth. This

route first passed through the Jamna-Ganges Doab touching at Jajjamau (Jhajamau), Abhapuri, Kuraha, Brahmashil and the tree of Prayaga (Allahabad). Thence it proceeded to Uwaryahar (Orissa) and Urdabishan (?) on the coast and onwards to Kanji (Conjeveram and Kunk). (2) From Kanoj or Bari to Banarasi (Benares) and thence to the mouth of the Ganges. The places mentioned along the route are Ajodaha (Ayodhya), Banarasi (Benares), Sharwar, Pataliputra (Patna), Mungiri (Monghyr), Janpa Dungumpur, and Gangasayara (Ganga-Sagar) where the Ganges flows into the sea. (3) From Kanoj eastward as far as Kamrup and northward to Nepal and the Tibetan frontier which passed through Bari, Dugum and Bihat, after which the country to the right is mentioned as Tilwat (Tirhut) where Mongolian flat-nosed features are observed and then stretch the mountains of Kamru (Kamrup). Opposite Tirhut on the left of the road was the country of Nepal. (4) From Kanoj southward, as far as Benarasi on the south coast. This route touched at Gwalior and Kalanjar and passed through the realm of Kajuraha and Mannakara (Balhara). (5) From Kanoj to Bazana, or Narayan,[1] the then capital of Gujerat. (6) From Muttra to Dhar, the capital of Malwa. Ujjain lay along this route. (7) From Bazana to Dhar and Ujjain. From Bazana one route led to Mewar passing through the capital Jattaraur (Chittor) and ownwards to Dhar. (8) From Dhar towards the Godavari, the road went to Bhumihara, Kand, Namuvur (on the banks of the

1. Identified with Nara anpur in the neighbourhood of modern Jaipur. See Elliot, Vol. I, pp. 393-95.

Nerbudda), Alispur (Ellichpur) and reached Mandagir on the banks of the Gadavar (Godavari). (9) From Dhar to Tana (Thana) on the Indian Ocean. The route lay across Mahratta-Desh (Maharashtra) and the province of Kunkan to reach Thana its capital. (10) From Bazana to Somnath on the south coast of Kathiawar. On the way lay Anhilwara (Pattan). (11) From Pattan to Thana, on the west coast north of Bombay. This route passed through Bhiroj(Broach). (12) From Bazana *via* Bhati to Loharani at the mouth of the Indus. The towns on this road were Bhati, Multan, Aror, Almanṣūrah, and Lohārānī (near modern Karachi) (13) From Kanoj to Kashmīr, marching north-west, one went to Shirsharaha, Thaneshar (Thaneshwar), Jalandhar. (14) From Kanoj to Ghazni, through Diyaman, Kuti, Anar, **Mirat** (Meerut), Panipat. Between Meerut and Panipat flows the Jaun (Jamna), onwards come Lauhawur (Lahore) east of the river Irawar (Ravi) then river Candahara (Chenab) the river Jailam (Jhelum), Purshawar Peshawar), Dunpur, Kabul and finally Ghazna (Ghazni). (15) From Babrahan to Addishtan, the capital of Kashmīr. (16) From Tiz in Makran, along the coast as far as Setubandha, opposite Ceylon. This route has already been described in connection with India's frontiers.

On the whole, Al-Bīrūnī's sense of distance does not seem to be perfect. In numerous instances, he hopelessly under-estimates distances, particularly with regard to Eastern and Southern India his ideas of mileage are very defective. But considering the then greater effectiveness of geographical barriers and the slow

means of communication, his knowledge was remarkable indeed.

COMMERCE AND MERCHANDISE AND TOWNS

Al-Bīrūnī speaks of numerous Indian towns and cities, explains their religious importance, refers to their fame as seats of learning and in many cases describes their role as centres of communications and places of commercial transaction. However, a systematic reference to the trade and commercial activities and the movement of merchandise is not found. Only here and there he speaks about the importance of certain ports, *i.e.*, Somnath, Lohārānī, etc., in relation to their importance as outlets for Indian exports and gates of exit for traffic to East Africa or the East Indies and China. For example, he says that Somnath was a harbour of seafaring people and a station for those who went to and fro between Sufālah in the country of Zanj (E. Africa) and China.[1] Al-Bīrūnī mentions the clove trade with Ceylon and says that the clove is called "lavang", because it is imported from a country called langa' (Lanka-Ceylon). According to the uniform report of all sailors, the ships which are sent to this country land their cargo in boats, *viz.*, ancient western "denars" and various kinds of merchandise, striped Indian cloth, salt and other usual articles of trade. Thesewares are deposited on the shore on leather sheets, each of which is marked with the name of its owner. Thereupon the merchants retire to their ships. On the following day the find they sheets covered with cloves by way of payment, little or much as the natives hap-

1. Vol. II, p. 104.

pen to own.[1] This throws light on the usual method of barter in trade resorted to in India's trade with the neighbouring lands. He also refers to the dwindling pearl fisheries of the Palk Strait when he says that in former times there were pearl-banks in the bay of Sarandīb (Palk Strait) but that they had been abandoned in his times, and that their place was taken by Sufālah pearls.[2]

Benares.—Benares is mentioned as a great centre of Hindu learning where a large number of savants had fled before the onrush of the Muslim conquests. It was also venerated as a religious centre and for the expounding of Hindu law and was a noted place of pilgrimage. Through it passed the important routes to the lower Ganges area and Bihar, North Bengal and Assam.

Kanoj.—Kanoj is mentioned as one of the most notable places in India, for the obvious reason that it represented the nucleus of the Indian political power on the eve of the memorable invasions of Sulṭān Maḥmūd. According to the savant Balabhadra its position was 26° 35′ latitude. Al-Bīrūnī points out that the river Jaun joined the river Ganges below Kanoj, which lay west of it. The country all around the great city was called Aryavarta (also called Madhyadesa—the middle of the realm). He continues, 'It is the middle or centre from geographical point of view in so far as it lies half-way between the hot and the cold province and also between the eastern and western

1. Vol. I, p. 309.
2. *Ibid.*, p. 211.

frontiers of India. But it is a political centre, too, because in former times it was the residence of their (Hindus') most famous heroes and kings.'[1] But at the time he wrote it was mostly in ruins and desolate, since the capital was transferred to the city of Bari, east of the Ganges (certainly for purpose of better defence). It was the nodal centre for many itineraries emanating in various directions. Kanoj formed at the time part of the realm of the Pala Kings of Bengal who ruled from Mongir (Monghyr)

Mahura (Muttra) is mentioned as the city of Vasudeva lying east of the river Jaun (Jamna), nearly 28 farsakh[2] from Kanoj. It was a holy place crowded with Brahmans and was venerated because Vasudeva was born and brought up in a place in the neighbourhood called Nandagola.

Mulasthana.—Almāmūra (Multan) was a noteworthy city at the time. The five rivers of the Punjab united below Multan at a place called Pancanada (Panchanad). Its latitude is given as 29° 40′. Al-Bīrūnī had himself resided here for some time. He has mentioned the small amount of rain from the monsoon by saying that there was no Varshakala (rainy season). Before the Muslim conquest it was also one of the holy places having a sacred temple and a pond. The Hindus continued to have a festival which they called 'Sambapurayvrata' celebrated in honour of the sun.

In connection with the first inroads of the Muslims

1. Vol. I, p. 198.
2. One farsakh=about three miles.

into India he adds, 'Ibn al-Qāsim entered Sindh from the side of Sijistān and conquered the cities of Bahmanwa and Mulasthana, the former he called Almanṣūrah and the latter Almāmūra. He entered India proper and penetrated even as far as Kanauj, marched through the country of Gandhara and on his way back, through the confines of Kashmīr, sometimes fighting sword in hand, sometimes gaining his ends by treaties, leaving to the peoples their ancient belief, except in the case of those who wanted to become Muslims. All these events planted a deeply-rooted hatred in their hearts.'[1]

According to Utpala, a native of Kashmīr, quoted by Al-Bīrūnī, 'Multan was originally called Kasyapapura then Hamsapura, the Bagapura, then Sambhapura and then Mulasthana, *i.e.*, original place, for "mula" means root, origin, and "tana" (Sthana ?) means place.'[2]

Lāhur (Lahore) is mentioned as a strong fortress town with a latitude of 34° 10′. The distance from Lahore to the capital of Kashmīr is given as 56 miles (obviously an under-estimate), half the way being plain and the rest rugged country.[3]

Lohōrānī (near modern Karachi) was situated at the mouth of the river Sindh (Indus) another arm of which joined the sea more eastward in the province of Katch at a place called Sindhu-Sagara. In 'Canon

1. Vol. I, p. 21.
2. *Ibid.*, p. 298.
3. *Ibid.*, p. 317.

Masudicus' (Al-Qānūn al-Mas'ūdī)[1] its latitude is given as 24° 40.'

Purshāwar (Peshawar) is mentioned as a notable town of Gandhara with latitude 34° 44' and had Buddhist monasteries.

Somnath was said to have a maritime situation and therefore was a nest of pirates. 'They are thus called because they commit robberies on sea in ships called "bira." The river Sarsati (Saraswati) joined the sea at a distance of a bowshot east of Somnath.' At this period, it seems, it was a busy port sharing in the commerce and traffic with East Africa, Ceylon and China. It was a place greatly venerated by the Hindus and its famous temple was a repository of enormous wealth. That was indeed the most powerful factor in attracting the attention of Sultān Mahmūd. Al-Bīrūnī gives the year of its destruction as 416 A.H. He adds that here was erected the 'linga' of Mahadeva. 'Soma' meaning moon and 'natha' meaning master, so that the word Somanatha meant master of the moon.[2]

It is in connection with the description of Somanatha that Al-Bīrūnī describes the phenomena of the ebb and the flow of the tides.

Ujain.—Uzain (Ujjain) was situated in Malwa; its latitude is given as 24° or, according to Brahmagupta, 16¼°. To the astronomers and the geographers its importance lay in the fact that to the Hindus it

1. Sachau: *Annotations*, p. 317.
2. Sachau: *Al-Bīrūnī's India*, Vol. II, p. 103

represented 0° longitude. Al-Bīrūnī refers to a common mistake among Muslim astronomers and geographers who gave Ujjain a coastal position. He says that in reality it was a hundred 'yojana' from the sea. He says that the Hindu prime meridian passed through in a straight line from Lanka (Ceylon) to Meru (in Himalayas, beyond India and that other positions on it were Ujjain, fortress of Rohitaka in Multan District, Kurukshetra in the plain of Taneshar (Thaneshwar), Mathura (Muttra), etc.[1] Ujjain was an important centre of communications.

Kashmīr.—Several references to the various geographical aspects of Kashmīr are found. It was an area of high mountain ranges and provided a sanctuary to Hindu scientists and other refugees escaping from the Muslim-dominated regions of the south. Al-Bīrūnī's short description of Kashmīr brings out clearly the various aspects of its physical and human geography and the inter-relation between them, [illegible], its mountainous nature, deep narrow river valleys, difficulty of communications, easier defence against foreign intrusion and close settlement in the vale of Kashmīr, etc. His own words explain it best, 'The inhabitants of Kashmīr are pedestrians, they have no riding animals nor elephants. The noble among them ride in palanquins called "katt" carried on the shoulders of men. They are particularly anxious about the natural strength of their country, and therefore always take much care to keep a strong hold upon the entrances and roads leading into it. In consequence, it is very difficult to have

1. Vol. II, pp. 206-7.

any commerce with them . . . The best known entrance to Kashmīr is from the town Barbahan, half-way between the rivers Sindh (Indus) and Jailam (Jhelum). Thence to the bridge over the river . . . thence you reach in five days the beginning of the ravine whence the Jailam comes . . . [1] thence leaving the ravine you enter the plain and reach in two more days Addishtan, the capital of Kashmīr, *via*, Baramula. The main city of Kashmīr covers a space of four farsakh (about 12 miles), being built along both banks of the river Jailam, which are connected with each other by bridge and ferry boats. The Jailam rises in the mountains of Haramakot, where the snow never melts nor disappears. Behind them there is Mahāchīn, *i.e.*, Great China. When the Jailam has left the mountains, and has flowed two days' journey, it passes through Addishtan (Srinagar). Four farsakh farther on it enters a swamp of three square farsakh. The people have their plantations on the borders of this swamp and on such parts of it as they manage to reclaim.[2]

The rainfall of Kashmīr was said to be heavy and commenced with the months of Sravana, lasting two and a half months. As a result, the rivers were in spate and timber would be seen floating down the Jhelum.

Naipal (*Nepal*).—There is also a brief and in-

1. More or less the modern Rawalpindi route through the valley of the Jhelum into Kashmīr.
2. Vol. II, pp. 206-7.

teresting note on the remote and isolated mountainous area of Nepal, depicting some of its geographical peculiarities. In Al-Bīrūnī's words, 'Opposite Tilwat (Tirhut) the country to the left (north) is the realm of Naipal. A man who had travelled in those countries gave me the following report—when in Tanwat he left the easterly direction—turned to the left (north). He marched to Naipal, a distance of 20 farsakh, most of which was ascending country. From Naipal he came to Bhoteswar (probably Al-Bīrūnī means Bhutan) in thirty days, a distance of nearly 80 farsakh, in which there is more ascending than descending country. And there is a water which is crossed several times on bridges consisting of planks tied with cords to two canes, which stretch from rock to rock and are fastened to milestones constructed on both side. People carry burdens on their shoulders over such a bridge, whilst below at a depth of 100 yards, the water foams as white snow, threatening to shatter the rocks. On the other side of the bridges the burdens are transported on the back of goats . . . Bhoteswar is the first frontier of Tibet. There the language changes as well as the dresses and the anthropological character of the people. Thence the distance to the top of the highest peak is 20 farsakh. From the height of this mountain, India appears as a black expanse below the mist, the mountains lying below this peak like small hills and Tibet and China appear as red. The descent towards Tibet and China is less than one farsakh.'

FINAL EVALUATION

As has already been mentioned, Al-Bīrūnī did not

write 'Kitābul-Hind' primarily as a geography of India. His work was unique in this respect that he wrote as an Indianist who touched upon a variety of subjects (religion, philosophy, literature, customs, laws, astrology, astronomy, chronology and geography). Certainly, it was not an easy task for a foreigner, howsoever learned and well-informed, and Al-Bīrūnī makes an honest admission in this respect when he says that 'I found it very hard to work into the subjects, although I have a great liking for them, in which respect I stand quite alone in my time.'[1] In addition, his entire approach was scientific and free from prejudices of any kind, religious or cultural, and Sachau rightly remarks that the work of Al-Bīrūnī is unique in Muslim literature, as an earnest attempt to study an idolatrous world of thought, not proceeding from the intention of attacking and refuting it, but uniformly showing the desire to be just and impartial, even when the opponent's views are declared to be inadmissible.

So much about Al-Bīrūnī's observations on India in general. From the point of view of geographical interest, he was a writer who often touched upon mineralogical, cosmographical and geographical subjects. In his work on *India*, in a number of chapters,[2] he dilates upon geography, cosmography and astronomy, but outside such sections there are numerous references to the geography of the country, *i.e.*, physical aspects, trade and commerce, towns and cities, routes

1. Vol. I, p. 24.
2. Chaps. XVIII to XXXI.

and communications, etc. Therefore, in the preceding paragraphs an attempt has been made to collect all those references and put them in a systematic form.

As to the merit of Al-Bīrūnī's geographical writings on India, it may be observed that, on the whole, he reveals himself as a very keen observer. His remarks on geological, meteorological and climatological aspects are sound, penetrating and thought-provoking. In astronomical and cosmographical matter he examines numerous Hindu sources and is usually severe in his criticism of them, at times verging on exaggeration. But his extent of information, and marshalling of relevant material, is truly amazing. Although his sense of distance is at fault at times, quite often an underestimate. All in all, Al-Bīrūnī gives a better idea of the inhabitable world than many of his predecessors: he believed in the southern extension of the African continent and the navigability of the ocean in the south. He clearly understood the phenomena of tides and explained how the increase and decrease in ebb and flow develop periodically and parallel with the moon's phases and he added that such things were known to the people living near the seashores and he refers to this in connection with the situation of Somnath. According to him, the educated Hindus to determine the daily ebb and flow of the tides by the rising and the setting of the moon, the monthly phases by the increase and the waning of the moon; but Al-Bīrūnī was of the opinion, that they did not know the physical causes of both phenomena. On the mathematical and astronomical side he discussed the antipodes and

the rotundity of the earth, its movements and indicated positions of numerous places. He attempted geographical inter-relationships. He was certainly an outstanding geographer on Mediaeval times.

CHAPTER IV

MATHEMATICAL GEOGRAPHY

MUSLIM contributions to mathematical geography were a part of that broader intellectual and scientific movement which commenced with the Abbasid age. Its growth and development can best be followed in relation to the four chief schools, which developed, *i.e.*, those of Baghdād, Egypt, North Africa, and Andalusia. In addition, after the decline of the central authority of the Caliphate at Baghdād, these scientific traditions were followed in the east, first at the court of the new provincial dynasties (particularly, the Buwaihids and the Ghaznavids), and later under the new-born intellectual zeal of some of the Mongol princes.

THE BAGHDAD SCHOOL

On the culmination of the age of conquest the Muslims had become masters of many of those territories which had served in the past as the cradles of civilisation and culture—Mesopotamia, Persia, and Egypt; while the conquest of Syria and Palestine early brought them into contact with the Nestorians who had been exiled from the Roman lands on account of their 'heresy'. Thus Greek knowledge and ideas were available to the Muslim world at an opportune moment when conquest and expansion were giving place to peace and culture. Simultaneously, the arm of Islamic expansion had reached the border-lands of Indian cul-

ture, and there is evidence of considerable contact with the cultural trends beyond the Indus in the exchange of embassies and the visits of learned individuals. From India came two works of special importance from our point of view, the 'Brahma-sphuta-Sidhanta' (better known to the Arab world as Sind-Hind) and 'Khanda-Khadyaka' (known as Ārkand—آرکند).[1] An Indian astronomer and mathematician, Brahmagupta, had composed both these works towards 628 A.D. and they were brought to Baghdād in 154 A.H./771 A.D. Indian scholars helped in the translation of these works by Al-Fazārī and Ya'qūb ibn Ṭāriq. A later influx of Hindu learning in the same direction was the intellectual influence exercised by the ministerial Barmak family, under Hārūn ar-Rashīd. The Iranian sources also did not go unnoticed and the famous Pahlavī Tables (Zij ash-Shaharyār—royal astronomical tables) compiled during the last days of the Sassanids were translated from Persian by Abu'l-Ḥasan. In point of time the Iranian and the Indian influences were earlier than those of Greek origin. Al-Fazārī's 'Kitāb al-Zij' (tables), compiled in the second half of the eighth century A.D., reflects Indian influence and the 'Cupola' of the earth is spoken of as 'Arin,' which according to Kramers is a false reading of Ujjainī (Ujjain) and points to this early contact.[2]

However, with the advent of Al-Māmūn the real scientific age of Islamic culture begins. In the intellectual sense, many-sided influences had already pene-

1. Datta and Singh : *History of Hindu Mathematics*, Part I, p. 83.
2. *Encyclopaedia of Islam*, Sup. No. I, p. 63.

trated deep into Muslim society. Then, above all, the weight of Māmūn's personality and liberal patronage of learning was harnessed to the advancement of science along with that of all branches of learning. The great Translation Bureau (بيت الحكمة) 'Bait-ul-Ḥikmat' had already been established under Hārūn al-Rashīd, where learned translators of all nationalities and creeds were employed—Hindus, Parsis, Christians, Jews, Muslims.[1] Books and extant material were collected by Māmūn from all countries regardless of cost, and translators were paid the weight of books in gold.[2] The liberality of this enlightened prince in the promotion of knowledge was remarkable indeed. He is said to have asked the Byzantine emperor to send the savant Leo to Baghdād in return for five tons of gold and an offer of permanent peace between the parties.[3] Among the translators employed at the 'Bait-ul-Ḥikmat' four were outstanding; Ya'qūb al-Kindī, Ḥunain b. Isḥāq, Thābit b. Qurra, and Al-Baṭrīq. There were also two well-known Hindu translators, Mankah and Ibn Dahan (also Doban), who knew Arabic.

The majority of Arabic geographical authors based their work more or less on the 'Almagest' (Al-Majisṭi' المجسطی) and the 'Geography' of Ptolemy. The first translation of the 'Almagest' by Nairīzi was of great consequence. Since Ptolemy himself had given a mathematical and an astronomical bias to his

1. Shiblī: *Al-Māmūn*, p. 164.
2. *Ibid.*, p. 170.
3. *Ibid.*, p. 175.

labours, his admirers followed the tradition. Therefore, the work of the astronomers, as far as it has bearings on Geography, is also to be taken into consideration, if we are to grasp the full meaning of Muslim contributions. Thus it will be useful to provide an outline of the work of some astronomers and mathematicians.[1]

The first series of regular observations with accurate instruments were conducted at Jundi-Shāpūr (S. W. Persia) during the first half of the ninth century, and were utilised by Aḥmad al-Nahāwandī and resulted in the preparation of his 'General Tables' (al-Zij al-Mushtamil) 308 A.D. But with the systematic work of translation in the reign of Māmūn and the establishment of observatories at Baghdād and Damascus began the real work on geographical matters. The great Caliph was not satisfied with the progress made by the Translation Bureau, and he allotted much greater resources to it and gathered together all the known workers in various scientific fields.

Ya'qūb al-Kindī, who knew many languages and wrote no less than 282 books, was the next famous translator of Greek works. The astronomers and mathematicians embodied their labours in the so-called 'Verified Tables' (al-Zij al-Mā'mūniy al-Mumtaḥan) which were prepared among others by Yaḥyā b. Abi

1. *The History of Arab Mathematics*, by Dr. 'Aṭāul-Ḥakim, Professor of Mathematics, Islamia College, Calcutta, which has been accepted as a thesis for the degree of Ph. D. by the University of Calcutta, contains useful biographical information.

Manṣūr, Sind b. 'Alī and Khālid b. 'Abdul Mālik al-Marwarūzī. These tables do not exist in their original form. The measurement of a degree of latitude entailed difficult geodetic operations,[1] but this was done with a remarkable approach to accuracy in about latitude 36° N, as a result of simultaneous observations between Tadmur (Palmyra) and Raqqa, the result being a little in excess of the actual, *i.e.*, by 2,877 feet.[2] Other findings in the verified tables relate to the obliquity of the ecliptic, the precession of equinoxes, and the length of the solar year, etc. Among these early astronomers was also Māshā'-Allāh son of Athārī or Sariya (b. 112 A.H./730 A.D., d. 200 A.H./815 A.D.), who made his own instruments and took careful observations. Khwārizmī had prepared an abridgement of Sind-Hind, and Al-Kindī who was well-versed in Greek did much useful scientific work relating to interpretations of the Alexandrian school. Another notable figure was Abū Ma'shar (Ja'far b. Muḥammad b 'Umar), a native of Balkh, who is known to Europe as Albumasar. He was a student of

1. The method undertaken will be described fully in its proper place in the section dealing with measurements.

2. Nallino : *Encyclopaedia of Islam*, Vol. I, p 498.

This statement refers to the result discussed later in this chapter where it is stated 'but adopted the larger of the two values, *viz*, 56⅔ miles.' It should be noted that by the word mile, here is meant the Arabian mile, not the English. One Arabian mile=6472.4 English feet. The circumference of the earth equal to 20,400 miles mentioned in this chapter is also reckoned in Arabian miles. Its value in English miles would be 24847.2. Taking the degree of latitude near the equator as equal to 68.7 miles (English), the circumference comes out as nearly 24,732 miles. See a discussion on this object in *Hyderabad Academy Studies*, No. 3, p. 108 (article by Prof. Muhammad A.R. Khān), entitled 'Need for better Co-operation between Oriental Scientists and Arabic Scholars.

Al-Kindī and died at Wāsiṭ at the ripe old age of a hundred years (272 A.H./886 A.D.). Europe knows him chiefly as an astrologer and there has grown up a tendency to belittle his astronomical work. But his tables (Zij Abū Ma'shar), deserve a high place. He was specially interested in celestial phenomena. Al-Māhānī studied the eclipses of the sun and the moon and the conjunction of the planets, etc., about the year 854-68 A.D., but unfortunately his works are not to be found beyond scattered references in a few places.[1]

The labours of the three sons of Mūsā b. Shākir, *viz.*, Muḥammad, Aḥmad and Ḥassan, occupy an important place among the works of the school of Baghdād. From 850 to 870 A.D. they were engaged in the metropolis taking observations from their State-patronised observatory at Bāb-at-Ṭāq (the Ṭāq Gate) on the Tigris. Their tables were greatly relied upon by Ibn Yūnus. Al-Battānī did his work at Raqqa from 877 to 918 A.D. and died in 929 A.D. Sedillot[2] thinks that European writers have attached undue importance to his works owing to their ignorance of the contributions of his predecessors. He says that Baṭṭānī played the same role among the Arabs as Ptolemy did among the Greeks, as both produced the sum-total of knowledge acquired till their time. Baṭṭānī's tables have been entirely lost and the Latin versions are full of mistakes. Thābit b. Qurra (d. 288 A.H./813 A.D.), a Christian scholar at the Court of Baghdād, translated

1. *The Hākimite Tables* of Ibn Yūnus.
2. *L'Histoire des Arabes.*

the Almagest' afresh. Ḥabash al-Ḥāsib worked at Baghdād about 300 A.H./919 A.D.

With the weakening of the authority of the Abbasid Caliphs, much of the work of these astronomer-geographers centred round the Buwaihid Court, and in this connection the name of Ibn al-'Ālam (d. 375 A.H./988 A.D) is noteworthy as the author of 'tables' based upon independent observations relating to the determination of the precession of equinoxes in an exact manner with the help of self-made instruments. But there is no trace of his work. He is reputed to be a teacher of 'Aḍud-ud-Dawla. 'Abdur Raḥmān aṣ-Ṣūfī (d. 376 A.H /986 A.D.), the famous author of 'Aṣ-Ṣuwar al-Kawākib ath-Thābita' and writer of a book on the astrolabe, Abu'l-Qāsim 'Abdullāh al-Kolūzī and Ja'far were among the contemporaries of Ibn al-'Ālam. Al-Rāzī (Abū Muḥammad b Zakariya, 840-902 A.D.), the famous Rhazes of the West, wrote on the form of the earth (Kitāb Ḥai'at-al-'Ālām) and contributed a treatise on the setting of the sun and planets (Risālat fī-Ghurūb ish-Shams-wal-Kawākib). He was born at Rayy and worked at Baghdād. The Buwaihid Court in the days of 'Aḍud-ud-Dawla and Sharaf-ad-Dawla had a galaxy of astronomers, mathematicians and other scholars. Among the rest, three more names figure prominently for their contributions on geographical matters. Al-Kūhī (Abu Sahal al-Waighān b. Rustam, d. 1004 A D.) was the designer of many instruments and the founder of the observatory at Baghdād under Sharaf ad-Dawla. Kūhī's works are lost, although he is credited with the

observation of the summer solstice and of an autumnal equinox.[1] Abu'l-Wafā (Muḥammad b. Muḥammad b. Yaḥyā b. Ismā'īl b. 'Abbās) was born in Buzjān in Khurāsān between Herāt and Nishāpur in 939-40 A.D. and died 998 A.D. He observed the obliquity of the ecliptic in 995 A.D. and prepared his 'tables' (Zij Shāmī). It is said that he was struck by the imperfection of the lunar theory of Ptolemy and on verification pointed out a third inequality which was no other than the one that was discovered by Tycho Brahe six hundred years later.[2] Abū Muhammad al-Khujandī in 992 A.D. made and used his own instruments. Hārūn b. 'Alī, maker of astronomical instruments, and his new 'tables' and Abū Isḥāq are other names that shed glory on the achievements of the Baghdād school.

About this time the ever-increasing chaotic political conditions and the waning prestige of the Caliphs brought to an end this great scientific activity at the metropolis. This most important feature, however, of the Baghdād school was the truly scientific spirit which had been the guiding principle of all its scholars. These scientists always worked from the known to the unknown, and experiment and demonstration were the foundations of their system.

EGYPT

By the end of the tenth century, Egypt had already broken loose from the Caliphate of Baghdād, and its capital was destined to become a new centre of scientific activity. The reigns of Al-'Azīz and Al-

1. Sedillot: *L'Histoire des Arabes.* 2. *Ibid.*

Ḥākim were the golden age of this school. Al-'Azīz (375 A.H./996 A.D.) founded the observatory at Cairo and rich endowments were allotted to it by Al-Ḥākim also. The outstanding work was that of Ibn Yūnus (Abu'l-Ḥasan 'Alī b. Abi Sa'īd 'Abdur Rahmān b. Aḥmad b. Yūnus), who died in 399 A.H./1009 A.D. He made a series of observations at his observatory on Mount al-Muqaṭṭam from 367 A.H./977 A.D. to 389 A.H./1007 A.D. Ibn Yūnus was certainly a worthy successor of Abu'l-Wafā and also relied greatly upon the labours of the three sons of Mūsā b. Shākir. As a result of his careful observations and measurements he produced the famous 'Ḥākimite Tables' (al-Zij al-Ḥākimī), which succeeded both the 'Almagest' and three earlier treatises of the school of Baghdād. Because of the high reputation these tables ultimately found currency in distant lands such as Persia, Mongol domains, China, and mediaeval Europe. Ibn al-Haithām (d. 430 A.H./1039 A.D.) was another noted mathematician and physicist who did much outstanding work in Egypt.

Al-Bīrūnī.—In point of time as well as from the view point of far-reaching significance in the advancement of all branches of geographical knowledge, stands out at this stage the dominating figure of Abū Raiḥān Muḥammad al-Bīrūnī. He is certainly one of the greatest intellectuals of all times.

Much of his geographical work has already been discussed,[1] but here only an outline of his contributions to the astronomical and the mathematical side

1. *Supra*, Chap. II.

of the subject is given. He combined in himself the understanding of all fields of geographical thought and in this respect, above all else, he measured up to the standard of Ptolemy. In many ways he even surpassed the Alexandrian. He possessed the great advantage of being well-versed in several languages, *i.e.*, Greek, Syriac, Persian, Arabic and Sanskrit. On his arrival in India with Sulṭān Maḥmūd, he devoted himself whole-heartedly to the study of Sanskrit with a view to getting access to the best sources of Indian thought, including mathematics, astronomy and chronology. He studied many Indian works including Brahmagupta's and among the Arabs all his great predecessors, including Al-Fazārī, Ya'qūb ibn Ṭāriq, Khwārizmi, Kindī, Abu Ma'shar and Jaihānī. In the opinion of a worthy scholar,[1] his work represents a scientific renaissance in comparison with the aspirations of the scholars working in Baghdād under the first Abbasids. Al-Bīrūnī devote a life-time to the service of science and learning. According to Yāqūt, there were only two days in the year, Nauroz and Meharjān, when he used to leave off his intellectual pursuits, otherwise his hand never left the pen.[2] He himself discussed the attitude of the real scientist in an admirable way in his introduction to *ānūn al-Mas'ūdī* (القانون المسعودى).[3] Al-Bīrūnī wrote no less than fifteen books and dissertations on topics like measurement and determination of latitudes and longitudes, finding of distances and co-ordinates of

1. Sachau : *Al-Bīrūnī's India* (Preface, xxvii).
2. *Mu'jam Al-Udaba*, Vol. VI, pp. 308-9.
3. Barni : *Al-Bīrūnī*, pp. 232-33.

the Ka'ba. Instruments and their uses were discussed in no less than five booklets giving various methods of constructing astrolabes, etc. In all, he was the author of several dozen books of which a large number dealt with geographical matters. Information about these books is obtained from some of his own great books, *viz.*, *Chronology of Ancient Nations* (*Al-Āthār al-Bāqiyah* الآثار الباقية), *Indica* (Kitāb al-Hind, كتاب الهند) and *'Canon Masudicus'* (القانون المسعودی) and from Ḥāji Khalīfa's *'Kashf al-Ẓunūn 'an Asāmī al-Kutab wa'l-Funūn,* (كشف الظنون عن اسامی الكتب والفنون) A bibliographical work.[1]

Al-Bīrūnī's astronomical and mathematical labours were largely collected in his 'Canon Masudicus,' a monumental work written in 1038 A.D. at Ghaznī and dedicated to Sulṭān Mas'ūd. The work still awaits full translation and publication. Besides this he also refers to astronomical, mathematical and geographical matters in his other works, *e g.*, *Indica* and *Kitāb al-Tafhīm al-Awā'il Ṣanā'at al-Tanjīm* (كتاب التفهيم الاوائل صناعت التنجيم) a sort of introduction to astrology and the 'Chronology of Ancient Nations.' In the domain of mathematics his labours were of a far-reaching character.[2] Certainly, Al-Bīrūnī can be regarded as one of the greatest geographers of all times. His services to geography were manifold and great. He very much developed the mathematical side of it, making geodetic measurements and determining.with

1. For details see Barni's *Al-Bīrūni*, Chap. IV, and Sachau: *Kitāb al-Hind* (Arabic text).

2. Ziā-uddīn Aḥmad, Opening Speech, 12th Mathematical Conference, Aligarh, December 1941.

a remarkable precision the co-ordinates of a number of places. He iutroduced a simple method of stereographic projections. In addition, he explained the occurrence of natural springs and artificial wells (artesian) by the laws of hydrostatics.[1] Geology and mineralogy too did not escape his attention. He discussed the earth, its axis and its movements, and threw much light on the Hindu methods of determining latitudes and longitudes. His contribution to the general geography of India[2] was also of a high order.

To this period also belongs a notable contemporary of Al-Bīrūnī, Abu 'Alī Sīnā (Abu 'Alī al-Ḥusain b. 'Abdullah b. al-Ḥusain b. al-'Aṭā al-Shaikh al-Ra'īs Abu Sīnā) 980 A.D. to 1036 A.D., known to the West as Avicenna. Along with Al-Bīrūnī and others, he was among the galaxy of scholars at the Court of Khwārizm before Sulṭān Maḥmūd's conquest overwhelmed it. He was celebrated for his philosophic discourses as well as for his skill in the practice of medicine, but physics and astronomy were of great interest to him. 'Tārīkh Ḥukamā' contains a list of forty-one books by him, which included treatises on astronomical instruments (copy of MS. in the Vatican), the place of the earth in the universe, heavenly bodies, and their uses, in answer to question about the characteristics of the equator. He also wrote a compendium of the Almagest. Ibn Sīnā's treatise on minerals remained one of the chief sources of geological knowledge in

1 G. Sarton: *Introduction to the History of Science*, Vol. I, p. 870.

2. See by the present writer, "Al-Bīrūnī's Geography of India", *The Calcutta Geographical Review*, March and December, 1943.

Western Europe until the Renaissance.

SPAIN

Like the eastern lands of Islam, Spain was also the cradle of this scientific activity, and Cordova, Seville, Toledo and Granada shared the honour from the middle of the tenth century A.D. onwards. Unfortunately, many works have been lost, and in a good number of Latin and Spanish works compiled under Alphonso X (1252-1282 A.D.), which are indebted to Muslim sources, either due recognition has not been given or names and subject-matter have been badly distorted.

Maslama al-Majrītī (d. 398 A.H./1007 A.D.) made a synopsis of the tables of Al-Baṭṭānī which were later made much use of by the authors of the 'Tables Alphonsine.' A very well-known name is that of Al-Zarqalī (Arzachel), who lived and worked towards the second half of the eleventh century A.D. (1029-88) and was the author of the 'Toledo Tables'. He was also the maker of many instruments, including astrolabes. Latin translations of some of his treatises are preserved in the Bibliotheque Nationale, but unfortunately the originals have been lost.[1] Other authorities were Jābir b. Aflāh (Geber) of Seville (d. between 1140-50 A.D.), and Ibn Rushd (Averroes), died 1198-99 at Marrākush and born at Cordova 520 A.H. The last named famous philosopher and scientist wrote a book on the motion of the heavens and an epitome of Ptolemy's 'Almagest.' Ibn Bājja (Avempace), died

1. Sedillot: *L'Histoire des Arabes*.

553 A.H./1129 A.D. and Al-Bitrūjī (Alpetragius), died 600 A.H / 1204 A.D. are among other Spanish writers on astronomy and geography. On the whole, the Ptolemaic findings were disputed in Spain and many corrections were attempted.

NORTH AFRICA

This part of the world of Islam also did not remain aloof from this universal scientific activity. Tangier, Ceuta, Fez and Morroco shared in this work and their scholars showed an indefatigable ardour, Among them the most celebrated was Abu Alī al-Ḥasan b. 'Umar al-Marrākushī, who produced his astronomical works about 1230 A.D. He travelled from the heart of Spain through a large part of North Africa and discovered the altitude of the pole in forty-one cities.[1] His book (Jāmi' al-Mabādī wa'l-Ghāyat) is entitled *The Beginning and the End*, and has been studied by the eminent scholar, M.J.J. Sedillot.[2] He was also the author of a treatise on astronomical instruments. His work has been characterised by an worthy scholar[3] as "the most important contribution to mathematical geography—not only in Islam but anywhere . . . It includes among other things the co-ordinates of 135 places, the observation having been made by himself in thirty-four of them. No mediaeval writer has taken equal pains to explain scientific methods and instruments."

1. Sedillot : *L'Histoire des Arabes.*
2. *Ibid.*
3. G. Sarton : *Introduction to the History of Science,* Vol II, pp. 41-42.

PERSIA AND THE EAST

During the Saljūq period some useful work was done at the court of the powerful Sulṭāns. The reign of Jalāl al-Dīn Malik Shāh (1072-1092 A D.) was outstanding. He surrounded himself with notable astronomers and gave his name to the Jalālī era which came about as a result of the reform of the calendar under the guidance of men like 'Umar Khayyām and 'Abdur Raḥmān. Rayy and Nishāpur' were the chief centres of his scientific activity.

Though the Mongol inundation later swept remorselessly over the fair lands of Islam, yet in a short time the victors submitted to the intellectual superiority of the conquered. Hūlāgū Khān (d. 1265 A.D.) collected at his court the leading astronomers and mathematicians. The most illustrious among these was Naṣīr al-Dīn al-Ṭūsī, the famous author of the 'Ilkhānī Tables'. A magnificent observatory was set up at Marāghah, near lake Urmiah in modern North Iran in 1259 A D. Al-Ṭūsī collected all the great available works from Khurāsān, Baghdād, Mawṣal and Syria. At its full culmination the work lasted for twelve years, and with it were associated many astronomers, including Najm al-Dīn Qazwīnī, Mu'ayyad al-Dīn, Muḥī al-Dīn, Fakhr al-Dīn and others. Though the tables of Ibn Yūnus were the basis of the Ilkhānī Tables, they were reproduced with many modifications. Al-Ṭūsī's pupil Quṭb al-Dīn Maḥmūd al-Shīrāzī continued his work. A suggestion has been made that some Chinese scientists also worked under Naṣīr al-Dīn, and this may perhaps explain the influence of Muslim scientific

thought upon China at this epoch.[1] The last bright phase of the work is associated with the scientific activity in the rising city of Samarqand. Ulūgh Beg (796 A.H /1393 A.D.—853 A H./144) A.D.), grandson of Tīmūr, summoned the leading light—Jamshed al-Kāshī, Qāḍī Zāde Rūmī, and Mu'īn al-Dīn Kāshāni to his court, and the Tables (Zij-i-Jadīd Sulṭānī), the preface to which was written by the Sultān himself, truly represent the last stage in the glorious traditions of the school of Baghdād.

ESTABLISHMENT OF OBSERVATORIES

As would be expected, the collection of such vast scientific data and the production of outstanding treatises were linked up with the establishment of up-to-date and well-equipped observatories, sometimes subsidised by the rulers but often also set up by the nobility and members of the aristocracy for their scientist friends. No sooner had beginnings been made with the cultivation of the sciences, as a result of the cultural contacts with non-Arab elements, than the observatory of Jundi-Shāpūr came into existence in the first half of the ninth century A.D. It was a small town in Khūzistān (S.W. Iran), founded by Shāpūr I, the Sāsānian, and later inherited the traditions of scientific work in the days of Anūshīrwān (550 A.D.). Today the site is marked by the ruins of Shāhābād. At this observatory worked men like Aḥmad al-Nahāwandī, the compiler of 'Zij-al-Mushtamil' (General Tables, 803 A.D.). The instruments

1. G. Sarton : *Introduction to the History of Science*, Vol. II, p. 14.

used are said to be very accurate. In the days of Al-Māmūn the most celebrated observatory was that of Shamasyā in the plains of Tadmur (Palmyra), established in 216 A.H. Māmūn appointed Yaḥyā b. Abi al-Manṣūr, Khālid b. 'Abdul Mālik Marwāruzī, Sind b. 'Alī and 'Abbās b. Sa'īd Joharī and several, other mathematicians and astronomers from all the four corners of the realm as directors. Observations were conducted with the help of the latest and most accurate instruments.[1] There was another state-owned observatory on Mount Qāsīyūn, two miles north of Damascus These and other observation stations were under a board of astronomers[2] headed by Yaḥyā b. Abi al-Manṣūr, and the data thus collected resulted in the preparation of the famous 'Verified Tables'. A little later, in 235 A.H , Al-Dināwarī (Abu Ḥanīfa Aḥmad b. Dā'ud) built his observatory at Isfahan, where he made observations and recorded in his 'Kitāb al-Raṣad'. Then he probably went back to his little home-town (Dināwar in Persian Iraq) where his observatory was pointed out for several centuries later. Al-Dināwarī was also a noted botanist and wrote a scientific book on the subject, *viz.*, 'Kitāb al-Nabāt'. He died in 282 A.H./805 A.D.[3] Reference has already been made to the observatory at Bāb al-Ṭāq (Ṭāq Gate) on the Tigris, in Baghdād, where the sons of Mūsā b. Shākir did much useful work. The Ṭāq Gate was at the eastern end of the bridge taking the Khurāsān road across the Tigris. It o ened directly

1. Shiblī : *Al-Māmūn*, p. 174 (quoting from *Kashf al-Ẓunūn*).
2. 'Aṭā'ul-Ḥakīm : *History of Arab Mathematics*.
3. *Encyclopaedia of Islam*, Vol. I, p. 977.

into the great market-street east of Baghdād from which the chief thoroughfares branched.[1] Later, Sharaf al-Dawla (988 A.D.) built an observatory at Baghdād which was situated in the garden of his palace. The instruments used were made by Al-Ṣāghānī, an outstanding instrument-maker of his age. Here also worked two famous scientists, Al-Kūhī and Abu'l-Wafā.

The work of Ibn Yunus was largely carried on at the observatory of Al-Muqaṭṭam. This observatory was built on the part of the range of hills which lies immediately east of Cairo and reaches a height of about 600 ft. overlooking the Nile. Both Al-Ḥakim and Al-'Aziz spent large sums of money in equipping and maintaining this observatory.

In the later period, in the east, two observatories attained a wide fame and both were the result of the patronage of science by Mongol princes. Hūlāgū Khān fixed his residence at Marāgha, 50 miles from Tabriz as the crow flies. The city was situated in a valley overlooking a fertile plain stretching up to lake Urmiah, nine miles away. On the plains submitted by his Vazir, Naṣīr al-Dīn Ṭusī, he erected a great observatory on a fortified hill west of the town. Today only traces of the foundation walls are to be seen. The observatory was fitted with many instruments. "The rays of the sun were admitted through a perforation in the dome so as to strike upon certain lines on the pavement, in such a way as to indicate, in degrees and

1. Le Strange : *Baghdād during the Abbasid Caliphate*, p. 178

minutes, the altitude and declination of the sun in every season and to mark the time and hour of the day throughout the year. On a big terrestrial globe were traced the inhabited regions, outlines of the oceans, rivers, lakes, islands, together with the descriptions of climatic conditions of various zones.[1] Ṣadr al-Dīn 'Alī b. al-Shujā' is said to have been the superintendent of the observatory and Ṭūsī appointed four advisers, one of whom was a noted astronomer of the town, Fakhr al-Dīn. In addition to instruments the observatory had a well-equipped library containing about 400,000 books[2] Lastly, Ulugh Beg built his observatory at Samarqand on the other side of the Kūhī. It was so big and well-equipped that it was regarded as one of the wonders of the world.[3] Jamshed al-Kāshī was the first superintendent of this observatory. The prince himself was a practical scientist and used the observatory. The Emperor Bābar, in his autobiography, says that he had seen the ruins of the observatory at Samarqand.[4] Here was prepared 'Zij-i-Jadīd Sulṭānī'.

INSTRUMENTS IN USE

Such scientific work, as well as various other measurements and observations, would not have been possible without the use of many instruments of precision. Of course, some of these were earlier inventions, but they had undergone a great deal of improve-

1. 'Aṭā'ul Ḥakīm : *History of Arab Mathematics.*
2. Jurji Zaidān : *'Ulūm-i-'Arab*, p. 277.
3. *Encyclopaedia of Islam*, Vol. IV, p. 905.
4. Maulānā Sulaimān Nadvī : Ziāuddīn Uṣṭurlābī Humāyūnī, *Ma'ārif*, August 1933.

ment. Those which were on the Greek model[1] were the Astrolabe (Aṣṭurlāb اصطرلاب). Latercus (al-Libna) —a square graduated plate for reading the distance between two objects—Annulus or Aquinoctialis (al-Ḥalqat al-I'tidāliyā), which was a graduated circular plate fixed at right-angles to the equatorial circle for reading the declination at the meridian, the triad, the sextant and the clepsydra. To these the Arabs added 'Dhāt al-Autār' (four square cylinders so arranged and contrived as to ascertain the time at different latitudes), 'Dhāt al-Simt wa'l Irtifā', al-Mushābahat bi'l-Manāṭiq (an instrument for reading regular distances), 'Ḥalqat al-Kubrā' and 'Ḥalqat-al Ṣughrā,' various kinds of sundials, and most probably some sort of compass,[2] and perhaps other instruments about which there is lack of information.

Before the invention of the telescope, the microscope, and the vernier, there can hardly be said to have been instruments of precision. But necessity is the mother of invention, and since there was the need for land-measure, for levelling and measurement of heights, the world developed several interesting instruments. In general, ancient surveyors measured distance by the use of a rope or a wooden rod. The unit of measurement varying in different localities. They laid off right-angles by the use of an instrument resembling the carpenter's square of the present day.[3]

1. 'Aṭā'ul-Ḥakīm : *History of Arab Mathematics.*
2. Still a matter of controversy ; will be dealt with presently.
3. Smith : *History of Mathematics,* Vol. II, pp. 344-45.

THE ASTROLABE

Of all the instruments in use by the Muslim astronomer-geographers the most familiar was the astrolabe in its various forms. The astrolabe has had a long history among astronomic-mathematical instruments. The word is derived from the Greek ἀστρου 'star' and λαβανειν 'to take',[1] since it was an instrument used not only for stellar but also for solar and lunar altitude taking. The basic instrument can be reduced to three fundamental types, *i.e.* as they represent the projection of the Celestial Sphere on a plane, or the projection[2] of this projection on a straight line, or the sphere itself without any projection. The astrolabe dates back at least to Hipparchus and perhaps even earlier to Eratosthenes. In many ways it is the forerunner of the modern sextant.[3] It became a favourite instrument with Muslim scientists who effected many improvements on the older model. Firstly, they used a flat instrument, astrolabium planisphaerum (Saṭḥī سطحى or Musaṭṭaḥ مسطح), in Arabic also called Dhāt al-Ṣafa'iḥ, consisting of tablets. It was a portable metal instrument in the form of a disc, ranging in size from 3.9 inches to 7-8 inches in diameter, and had a handle ('Urwa) through which passed a suspending ring (Ḥalqa, 'Ilāqa), by means of which it could be suspended in a vertical position.[4] As a result of many improvements the Muslim scientists used the astrolabe for

1. *Encyclopaedia Britannica*, 13th edition, Vol. I, p. 793.
2. Nallino : *Encyclopaedia of Islam*, Vol. I, p 501.
3. Dickinson and Howarth : *Making of Geography*, p. 108.
4. Nallino : *Encyclopaedia of Islam*, Vol. I, also see Donaldson : The uses of the Astrolabe, etc., *Islamic Culture*, January 1945, pp 49-53.

finding the height of any star on immediate observation and thereby knowing the hours of day and night already spent ; then in addition to solving many problems of spherical astronomy (with which we are not concerned here) it was useful in undertaking geodetic operations, *e.g.*, for calculating the distance of an inaccessible place, the height of a building, the depth of a well whose diameter could be measured. It is obvious that such a small instrument would not give great accuracy, and especially in the case of observations connected with celestial phenomena where, on account of the precession of the equinoxes and the diminution of the obliquity of the ecliptic, variations occur over a period of time. The astrolabe intended for use in the northern hemisphere was called the 'Shimālī' and the one for the southern hemisphere the 'Janūbī'. The one which was called the 'perfect' (Kāmil) had additional marking to show the circle of the sun's equation. It was only the advent of the telescope, the modern sextant, and the theodolite which gave precision to observations and measurements. In fact, till the seventeenth century the mariners went on using the astrolabe for the direct measurement of the altitude of the sun.

In the course of time Europe learnt about the perfected astrolabe from Arabian sources, and on account of its utility it became known as a 'Marvel of Convenience and Ingenuity' and was also called the 'Mathematical Jewel'.[1]

It is not intended to give a history of astrolabe-

1. *Encyclopaedia Britannica*, 13th edition, Vol. I, p. 795.

making, but some of the outstanding makers of this instrument and writers on the subject may be mentioned in passing. Among the earliest makers of the astrolabe among the Muslims were Al-Fazārī (d. 796 A.D.) and Al-Nairīzī (d. 922 A.D.). Al-Khāzin wrote a book on it, 'Kitāb Zij al-Ṣafā'iḥ.' Al-Khujandī (d. 382 A.H./992 A.D.), who lived in the Court of Fakhr al-Dawla the Buwaihid, constructed an instrument known as 'Sudas al-Fakhrī,' (some kind of astrolabe), by means of which latitudes of places were found out. It has been called the forerunner of the modern sextant.[1] Al-Jīlī (971-1029 A.D.) also wrote a book on the astrolabe. In the observatory of Sharaf al-Dawla at Baghdād, towards 1000 A.D., were two famous instrument-makers, Al-Ṣāghānī and Rustum al-Kūhī. Al-Bīrūnī was not only a great writer on instruments in use, *e.g.*, in several Risālas[2] on 'Aṣṭurlāb' and the 'Kitāb al-Tafhīm':[3] among others he mentions Al-Khujandī, his friends and contemporary Abu Sa'īd al-Sinjarī (maker of a big astrolabe), and Al-Jīlī; but he himself was no less an inventor of many instruments. In the West, Al-Zarqalī (1029-1088 A.D.) was the outstanding maker of astrolabes and his 'Safiha' exerted the most far-reaching influence on the use of the improved astrolabe in Europe. Mathematicians, astronomers, sailors and mariners remained familiar with it for several centuries. Later, in the East, Badī' al-Zamān (d. 1139-40 A.D.) Aṣṭurlābī was the most efficient astrolabe-maker of the time. He also constructed a celestial sphere

1. Barnī : *Al-Bīrūnī*, p. 12 (see footnote).
2. *Ibid.* (Also see *Al-Bīrūnī's India*, Arabic text edited by Sachau).
3. Sarton : *Introduction to the History of Science*, Vol. II, p. 12.

and globe, among other instruments. Muẓaffar al-Ṭūsī is known for his 'Aṣā'i-Ṭūsī' and Al-'Urdī was the most celebrated of the instrument-makers of the Marāghah observatory. It is said that he was the supervisor of a foundry and tool-shop which was attached to the observatory. He was in all probability the author of a treatise describing the instruments used at Marāghā. Among other instruments, he was the maker of a Hipparchus diopter (alidade) and parallactic rulers (after Ptolemy).[1] It is also surmised that at this observatory they also had instruments with which they could distinctly perceive remote objects (maybe, a sort of miniature telescope).[2] The continued use and construction of good instruments is evident in the days of Ulūgh Beg at Samarqand. Very late in the day, the craft spread to India, where from Humāyūn's time onwards the family of Ḍiā-ud-Dīn Aṣṭurlābī constructed many astrolabes for three or four generations.[3]

Religious and astronomical interest made it incumbent upon the astronomers to lay particular stress upon the accurate determination of the geographical latitudes and longitudes of places. Above all, the precise knowledge of latitudes was used in the construction of horizontal sun-dials ('Baseta') which, like the town clocks in our own time, always adorned the open squares where there was usually a mosque. These

1. Sarton: *Introduction to the History of Science*, Vol. II, pp. 1013-15 (here the question of 'Urḍī's authorship of the treatise on instruments is discussed and Sarton gives a list of the instruments made by him).

2. According to 'Aṭā'ul-Ḥakīm, *History of Arab Mathematics* (quoting from Jourdian).

3. Maulānā Sulaimān Nadvī, "Ḍiā-ud-Dīn Humāyūnī Aṣṭurlābī," in *Ma'ārif*, August 1933.



"Muslim Contribution to Geography." 4 *Facing Page 110.*

ASTROLAB

This is Plate No. VIII : Husain b. 'Ali A. H. 709. Recto and verso.
Courtesy of the Fitzwilliam Museum, Cambridge.
Taken from "Islamic Astrolabists and Their Works" by L.A. Mayer and published by : Albert Kundig, Geneva 1956.

sun-dials were constructed with regard to the latitude of a particular place.[1] It is a legacy of those times that in many mosques today along with a clock inside are found sun-dials adorning the court-yard.

The invention of such a useful instrument as the mariner's compass in some quarters[2] is still regarded as obscure, and the claim of originality is divided between the Chinese, Greeks, Etruscans, Finns, Italians and Arabs. The theory of Chinese origin is now largely discredited, as it is pointed out that "the first practical use of the magnetic needle was credited by the Chinese themselves to foreigners, who were in all probability Muslims."[3] The extensive Muslim maritime activity would certainly warrant the use of such an instrument. What has given cause for speculation, however, is the fact that according to some the earliest reference to it outside of China is found in Europe in the Latin writings of Alexander Neckam,[4] but the Englishman dose not speak of it as a novelty. Muslim references are said to be later, perhaps for purpose of secrecy mention of the instrument was avoided. But Maulānā Sulaimān Nadvī[5] asserts that the earliest mention of the 'Qutb-Numa' is found in Idrīsī's work, who says that it was commonly used among the Arabs. The floating compasss and its early popularity with the

1. Schoy ; "Geography of the Muslims of the Middle Ages," *Amcrican Geographical Review*, Vol. XIV, 1924.

2. *Encyclopaedia Britannica*, Vols. V-VI, pp. 806-8.

3. Sarton : *Introduction to the History of Science*, Vol. II, p. 629.

4. *Ibid.*, p. 630.

4. For Maulānā's criticism of the views expressed in *Encyclopaedia Britannica* and for further details proving Muslim origin see 'Arab Navigation', *Islamic Culture*, October 1942.

Muslim sailors of the Indian Ocean is a historical fact, (see 'Jawāmi' al-Ḥikāyāt' by 'Awfī).

MEASUREMENT OF LATITUDES AND LONGITUDES

It should be remembered that methods and instruments for the precise determination of position, *i.e.*, latitude and longitude, are essential to navigation and the construction of accurate maps, Generally speaking, latitude may be determined by the measurement of the altitude of the sun, the pole star, or the upper and lower culminations of a circumpolar star. The earliest instrument known for measuring the elevation of the sun was the gnomen (Miqyās) which consists simply of a vertical rod, from the length of whose shadow the altitude of the sun can be calculated. It is traced back to the Babylonian times. It has often been asserted that in the matter of these measurements Muslim astronomer-geographers in no way surpassed the 'Almagest' of Ptolemy. But such a view is based upon insufficient knowledge of the work done by the Muslim scientists. It has been rightly pointed out that "various Arabic geographers carried out unusually thorough researches leading to the determination of geographical latitudes, and thereby contrived methods as original as the results occasionally were accurate."[1] For example, Ibn Yūnus first called attention to the error resulting in the reckoning of latitude from the shadow of the gnomon, because in this manner errors of as much as 15° creep in, as the shadows are cast from the upper edge of the sun and not from its central

1. Schoy: Geography of the Muslims of the Middle Ages. *American Geog. Rev.* Vol. XIV, 1924.

point.[1] The early astronomers, Al-Khwārizmī, Farghānī, Ḥabash al-Ḥasib and Al-Baṭṭānī made use primarily of Greek and Indian methods of finding latitude. But Schoy points out that Khwārizmi hinted at the use (though he did not apply) of the method of the culmination of a circumpolar star. Ibn al-Haitham (965-1038 A.D.) devoted a separate work to the exact calculation of latitude.[2] He recommended the taking of a bright fixed star for the precise determination of the tatitude of the pole. But Al-Bīrūnī came out with a more scientific and original suggestion in his masterpiece 'Qānūn al-Mas'ūdī,' applying the method of circumpolar stars to the sun. His latitude of Ghaznī found by this method was accurate, and he found the latitude of numerous places which are mentioned in 'Kitāb al-Hind,' 'Kitāb al-Tafhīm,' and 'Qānūn al-Mas'ūdī.' Other, almost exact calculations were those of the three sons of Mūsā b. Shākir at Baghdād, Al-Māhānī at Surra-man-ra'a, Ibn Yūnus at Al-Muqaṭṭam, and Ulugh Beg at Samarqand.

As far as the determination of longitude is concerned, it was a much more difficult problem until the eighteenth century, for two reasons,—firstly, there was the problem of choosing a prime meridian, secondly, the difficulty of calculating the angular distance east and west of this line. Ptolemy had used the meridian of the Fortunate Isles (vaguely identified with the Canaries) as his standard.

1. Schoy : *Geography of the Muslims of the Middle Ages*, American Geog. Rev., Vol. XIV, 1924.

2. *Ibid.*

In the determination of longitude, the Muslims either began in the farthest west, like the Greeks, and counted through 180° to the east, or sometimes the reckonings were made east and west of an arbitrary prime meridian which at times was supposed to pass through the 'Cupola of Arin' (Qubbat al-Arḍ) lying at the centre of the earth's surface on the equator. 'Arin' was perhaps a corrupt reading of the name of the Indian town, Ujjain. Before Al-Bīrūnī's time a common method of finding longitude was to make use of the eclipses of the moon. The result was that inaccuracies to the extent of several degrees cropped up. He is said to have been the first to point out the so-called terrestrial method of calculation. "Having determined accurately the shortest linear distance between the points and the latitudes of each, Al-Bīrūnī calculated difference in longitude from the data thus acquired. This he did in correcting older figures of the distance in longitude between Alexandria and Ghazna, together with the longitude of a number of intermediate points. This calculation is discussed in a chapter of his famous astronomical geography—'Qānūn al-Mas'ūdī,' a work comparable to the 'Almagest' of Ptolemy."[1]

The technical procedure of the Arab geographers in determining longitude by the observation of the eclipses of the moon was fully elaborated by Ibn Yūnus.[2] An outstanding improvement as a result of the careful calculations of longitude by Muslims was the correction in the exaggerated length of the Medi-

1. Schoy : *Geography of the Muslims of the Middle Ages.*
2. In *Ḥākimite Tables.*

terranean Sea, which was a legacy of the Ptolemaic error of no less than 17°

THE EARTH : ITS SHAPE, SIZE AND MOVEMENTS

The opinion on the sphericity of the earth was divided in the Europe of the Middle Ages; one can find ideas ranging from the absurdities propounded by Cosmas to the hesitation of the Christian mind to accept the pagan views. St. Augustine[1] regarded roundness as incredible. On the whole the question remained highly hypothetical and the mediaeval European mind steeped in ignorance born of religious obscuranticism was not prepared to accept the idea of sphericity, which sounded somewhat paradoxical and fantastic to it. Thus a great deal of unscientific and at times amusing argument centred round the idea of the antipodes and the human life therein. While on the other hand, most of the Arab geographers believed in the sphericity of the earth, as, according to Honigmann, the Eratostherian theory of climate so fully elaborated by them implied such a belief. The majority, therefore, held to the idea of the earth being a sphere floating in space. Ibn Rustah summarises these ideas in his 'Work of Costly Treasures.'

As to the size of the earth, much speculation along with serious attempts at measurement had gone on from very early times. Among such attempts the following may be noted with reference to the earth's circumference.

1. Sarton : *Introduction to the History of Science*, Vol. II, p. 46.

Greek ... Aristotle 45,964;[1] Eratosthenes 25,000;[2] Posedonius 18,000 and Prolemy 18,000.

Hindu ... Aryabhaṭa 33,177; Brahmagupta 50,936; Achārya 48,714.

No sooner had work begun in Muslim scientific astronomical and mathematical fields than geodetic operations engaged the attention of scholars. The first outstanding attempt at the measurement of the earth's circumference was made by Al-Māmūn's scientists under the supervision of the sons of Mūsā b. Shākir in the plain of Sinjar in the Syrian Desert. The method that they adopted was that a number of observers setting out from the same point walked some to the north and the others to the south, until they saw the pole star rise and sink one degree. They used a rope, fixing it to pegs, and when it was measured, giving the total distance covered, the mean of the results was taken. They actually did not keep this mean but adopted the larger of the two values, *viz.*, 56 miles.[3] The circumference thus worked out to 20,400 miles. The radius of the earth according to Al-Baṭṭānī and Al-Farghānī was 3,250 Arabian miles and Ibn Rustah put it at 3,818.[4] But Al-Bīrūnī excelled everybody. In chapter VII of 'Qānūn al-Mas'ūdī' he discussed the question of the circumference of the earth. He undertook measurements in a level

1. Results are given in English miles, unless otherwise stated.
2. Geographical miles.
3. Arnold and Guillaume, *Legacy of Islam*, p. 381. But Shiblī (see *Al-Māmūn*, p. 173) gives the reading as 66-2/3 miles, quoting Ibn Khallikān.
4. *Encyclopædia of Islam*, Vol. I, p. 499.

plain in Northern Dahistān in Jurjān, but the attempt fell short of success; he therefore brought the task to completion in India by measuring the so-called horizontal depression from a mountain, and the result was 56 miles, 050″. In this connection he very favourably commented on the calculations carried out under the guidance of the sons of Mūsā b. Shākir. The question of the motion of the earth was not decussed in contemporary Europe and the planet was considered to be stationary in the centre of the Universe. But several Muslim geographers, *e.g.*, 'Alī b. 'Umar al-Kātibī, Quṭb al-Dīn Shīrāzī and the Syrian Abu'l-Faraj, doubted the idea of rest and hinted at a daily rotation, though the idea was finally rejected because that involved the complete understanding of the laws of motion, which had to wait for Galileo and Kepler. Kut the very fact that doubts were expressed about Ptolemaic findings showed that the Muslims had a commendable progressive tendency and cleared the way for the Copernican reform in 1543.

Al-Bīrūnī accepting the vague Babylonian and Hindu conceptions, believed in the turning of the earth on its own axis. He believed in the movement of the sun round the earth. But being a scientist, he had an open mind, and therefore spoke with admiration of the suggestion of Abū Sa'īd Sinjarī regarding the possible movement of the earth round the sun.[1] Later the question of rotation was taken up by 'Umar-al-Kātibī al-Qazwīnī, one of the scientists at the Marāghah

1 Maulānā Sulaimān Nadvī: 'Ilm-Jughrāfiya al-'Arab, *ad-Dīā*, January 1933.

observatory, who prepared an edition of the 'Almagest' (d. 1277 A.D.). In his 'Ḥikmat al-'Ain' he introduced the ticklish argument, "If it, *i.e*, the earth, did not rotate, could a flying bird keep up with it?" Answering[1] he said, yes, because the atmosphere might be turning together with the earth and drag the bird. But he was overpowered by the Aristotelian prejudice against accepting such a revolutionary contention and therefore he was unable to anticipate Galileo and Kepler. He added, "All terrestrial motions take place in a straight line and therefore we cannot admit that the earth should move in a circle."[2] Then, among others who took up the question was Quṭb al-Dīn al-Shīrāzī (1236-1311 A.D.), a pupil of Naṣīr al-Dīn Ṭūsī. An important work on astronomical geography was his 'Nihāyat al-Idrāk fi Dirāyat al-Aflāk' (On the highest understanding of the knowledge of spheres), based on Ṭusī's 'Tadhkira', and included discussions on geography, geodesy and meteorology. He discussed the question whether the earth was at rest or not. Shīrāzī too could not go beyond the prevailing conceptions about motion and concluded in favour of rest and conceived of the earth as an immobile sphere placed at the centre of the Universe. But the fact that he discussed the problem at length[3] was in itself creditable.

1. Barnī : *Al-Birūni*, pp. 210-11.
2. Sarton : *Introduction to the History of Science*, Vol. II, p. 764.
3. *Ibid.*, p. 1018.

CHAPTER V

CARTOGRAPHY

THE Arabs were not as successful in cartography (the science of map-making), as in other geographical fields. One of the causes was, perhaps, the Arab love of decoration. In many cases the picturesque was preferred to the accurate. But it should not be forgotten that their contributions were made at a period when Western cartography was little more than an attempt to provide theological texts with decorative illustrations. The Muslim map-makers carried on the tradition of classical achievements and in many respects advanced beyond it. Though their works drew inspiration from Ptolemy, most of the Arab geographers did not follow him slavishly as their knowledge of geography had advanced considerably. In general, the representation of the world on a map shows a return to the older Greek and Babylonian conceptions of an encircling ocean. But this was perhaps due to the wider maritime activities of the period, which brought them to the shores of the Atlantic on the one hand and to that of the Pacific on the other. They discarded Ptolemy's idea of the connection between Africa and South-Eastern Asia, making the Indian Ocean a landlocked sea. Nevertheless, in several works facts and fiction are found curiously mixed up.

Throughout the Middle Ages there existed a close relationship between the extension of maritime activity

and navigation and the development of cartographic skill and information. Many European writers (some orientalists being an exception) often assumed that navigational traditions first developed around the Aegean waters.[1] While the fact remains that long before seafaring developed within the limited compass of the Eastern Mediterranean, what can be called oceanic navigation, had become common with many Eastern peoples, *i.e.*, Indians, Chinese, Arabs and Persians. In fact, after the Romans, European contact with the oceans only began a millennium later with Columbus and Vasco da Gama.

The evidence of deep sea navigation by Indians is writ large in the existence of prosperous Hindu colonies in Malaya, Sumatra, Java, Cambodia, Annam and Champa (Siam) towards the first century A D. and the later continuation of this cultural contact with Indonesia across the Bay of Bengal. The maritime activity under the Chalukyas, Sri Vijaya kings and the Chola emperors was no less remarkable.[2]

NAVIGATION IN THE INDIAN OCEAN

The advent of Buddhism in China marked the beginning of their interest in India, Burma and Ceylon. Priests and pilgrims began to visit these countries by land as well as by sea. It is, however, only from the third century of the Christian era that authoritative records of Ceylon are found in Chinese literature. Two

1. Panikkar : *India and the Indian Ocean*, pp 22-23.
2. *Ibid.*, pp. 32-33.

important Chinese travellers, Fa-hsien (399-414 A.D.) and Huien Tsiang (629-45 A.D.) have left records of their journeys. The return journey of Fa-hsien *via* Ceylon and across the Indian Ocean proves the existence of the maritime connection with China, but there is little evidence of their trading activity by sea. They were mainly engaged in exchanging goods with the Arabs who had founded settlements of their own all along the shores of Southern Asia and South-eastern Asia waters up to Sumatra, Java and the Moluccas.

Persian navigators of the Arabian Sea and the expedition against Ceylon belong to the times of Noushīrwān, about early sixth century A.D.

Then towards the middle of the seventh century A.D. dawned a new day for the Arabs with the rise of Islam as a great spiritual, social and political force. Within a hundred years of the death of the Prophet they became the masters of a mighty empire greater than that of Rome. Their domination of the seas extended from the two basins of the Mediterranean, down the Red Sea to the known lengths of the Indian Ocean. Here history presents us some strange and interesting facts. In the West, the Muslims held sway along the western, southern and the eastern regions of the Mediterranean and had possession of several islands there. The Red Sea was virtually an 'Arabian Lake.' In the Indian Ocean, however, their direct political control did not extend in the east beyond the coastal areas of the lower Indus. Yet we find the strange spectacle of numerous Arab settlements with the full

enjoyment of their religious and social practices, along the Konkan, Malabar and Coromandal Coasts, in the Maldives and Ceylon, and their commercial activity extended to the Andamans, the Nicobars, the Arakan Coast, Malaya, Sumatra and Java. Islam had come to these regions without any political support whatsoever and remained rooted to the soil for centuries, away from the turmoils of Maḥmūd's invasions of India and the struggle between the Cross and the Crescent in the world of the West. Here trade or religion did not follow the flag, as they most certainly did a few centuries later with the rise of European commercialism. The Arabs' predominance in the trade of these seas was based upon their love of adventure and ability to sail over the open seas. This along with the simplicity of their religious belief, earned for them the amiable and friendly response of non-Muslim elements in the Eastern world. The extensive Arab historico-geographical literature dealing with this part of the world gives a revealing picture of these peaceful commercial relations. There is not a single instance of discord between the Muslim and the non-Muslim rulers or peoples culminating in war. Then appeared the Portuguese, heralding the advent of European commercialism in the Indian Ocean. History tells us of the bitter struggle[1] that these Westerners had to wage not only against the Arab and Muslim elements but against the common hostility of Muslim and non-Muslim alike. The peoples of Malabar, the Maldives and Ceylon with their Muslim friends offered a stiff

1. See Shaikh Zainuddīn's *Tuḥfat-al-Mujāhidīn*, for a detailed picture of this protracted struggle.

though unavailing resistance to the Europeans.

CONDITIONS OF NAVIGATION IN FREQUENTED SEAS

In the Mediaeval days of Arab navigation the wind and weather were a mu^h more limiting factors and the accompanying cyclones a greater menace than at the present time. The sailings were directly influenced by the change of seasons. The monsoon brings with it the rainy season with frequent squalls and dirty weather. There is a succession of cyclones following the trend of the monsoon, and therefore sailings over the Arabian Sea and the surrounding waters, northward or southward, depended on the direction of the monsoon. The uncertainty of weather associated with cyclones and their great speed,[1] especially north of the Equator, averaging five to nine miles per hour between 11 degrees N. to 20° N. Lat., made the sailings round Ceylon no holiday cruise for generations of those brave Arab sailors. The invention of the compass by them [2] was of tremendous importance, and the compass remained the guide of navigators whose destination was Ceylon, the Sunda Islands, or the China Seas. The perfection of the astrolabe was also put to common use in sailing. The lack of other precise instruments such as we possess today was made up for by long experience of wind and weather handed down from generation to generation. Several Arab

1. S. Rogers: *The Indian Ocean*, p. 169.

2. Regarding the controversy about the invention of the compass seen by the present writer, 'Muslim Contribution to Astronomical and Mathematical Geography,' *Islamic Culture*, Hyderabad, Vol XVIII No. 2, April, 1944. Also *infra* Chap. III.

writers like Sulaimān Tājir, Abū Zaid, Buzurg ibn Shaharyār and Mas'ūdī have spoken about these conditions. But the peak of Arab knowledge of these seas was reached on the eve of the advent of the Portuguese. To this period belong the valuable works of men like Aḥmad ibn Mājid (Kitāb al-Fawā'id, 1439-90) and Sulaimān al-Mahri ('Ulūm al-Baḥrīyah, early sixteenth century). It is a legacy of this knowledge that many of the commonest terms in modern meteorological terminology are of Arabic origin, *e.g.*, typhoon for Ṭūfān (طوفان), monsoon for Mausim (موسم), etc.

The earlier of the above-mentioned works was that of Shihāb al-Dīn Aḥmad b. Mājid who wrote sailing instructions for the Indian Ocean, Red Sea, Persian Gulf, Western China Sea and South-eastern Asia waters. Mājid[1] was born at Julfar in Arabia and came from a well-known family of seamen and navigators. He was at Malindi (E. Africa) when Vasco da Gama arrived there and the latter having succeeded in securing his services as an escort and guide was able to sail across to Calicut in 1498. It is related by Barros that this 'Mu'allim' (expert in navigational matters) showed Vasco da Gama a map of the whole coast of India arranged with meridians and parallels. Gama showed him the big wooden astrolabe and others made of metal. But on seeing these the Arab navigator expressed no surprise and informed the Portuguese leader that in his part of the world they used better instruments as well as took guidance from the stars and

1. See *Encyclopaedia of Islam*, Vol. IV, p. 365, *et seq.* (Article by G. Ferrand).

then showed the European an instrument made of three plates.

The period during which Ibn Mājid published his 30 nautical texts lies between 1462 and 1489-90. The most important work was 'Kitāb al-Fawā'id, (Principles of Navigation, etc.) concluded in 1489-90. The book seems to be a compendium of the known knowledge of theoretical and practical navigation. It deals with the legendary origin of navigation, lunar motions, magnetic needle, sea-routes of the Indian Ocean and the latitudes of a number of harbours in that ocean and the China Sea. In addition, it describes the West Coast of India, the ten large islands (Qumr or Madagascar, Sumatra, Java, Al-Ghūr or Formosa, Ceylon, Zanzibar, Bahrain and Socotra, etc.), the monsoon with dates of commencement either ways. At the end it mentioned in detail the anchorages, shallows, banks and reefs of the Red Sea. G. Ferrand rightly remarks: "We must regard it as a kind of synthesis of nautical science of the later years of the Middle Ages. Ibn Mājid is at the same time the earliest of the modern writers of nautical guides. His work is admirable. The description of the Red Sea, for example, has never been surpassed or even equalled. ... The information given on the monsoons, local winds, routes and latitudes for crossing the whole of the Indian Ocean, are precise and detailed as could be expected at this period."[1] The work of Mājid was of such usefulness and his name so famous that his memory was still alive in the Maldives and along the Indian

1. *Encyclopaedia of Islam*, Vol IV, p. 365.

littoral in the first half of the nineteenth century. As late as the middle of the same century, there is record to show that people sailing out of the Red Sea into the vast expanse of the Indian Ocean used to say 'Fātiḥa' in honour of Shaikh Mājid.[1]

Sulaimān b. Aḥmad b. Sulaimān al-Mahrī who was a younger contemporary of Mājid wrote five treatises in prose on sailing instructions about the first half of the sixteenth century, of these the third 'Al-'Umdat al-Mahrīyah fī' ḍabṭ al-'Ulūm al-Baḥrīyah' has chapters on nautical astronomy, sea-routes in the Arabian Sea, East African coastal areas, Bay of Bengal and Malayan and Indo-Chinese Coasts, routes along a large number of Indian Ocean islands, monsoons of the Indian Ocean in detail. Some outstanding voyages are also described.[2] Mahrī's work was translated by Sidī 'Alī ('Alī b. al-Ḥusain, d. 1562), the Turkish Admiral who wrote his 'Muḥīṭ' in 1554. A little earlier, Pirī Raīs had written an oceanographic work on the Mediterranean (Baḥrīyah) in 1523 and supplemented it with maps of all parts of the coast of that sea.[2] Another writer of this category was Al-Sifaqsī ('Alī b. Aḥmad b. Muḥammad al-Sharqī) whose work was written in 1551.

The remarkable Portolano charts came much later

1. G. Ferrand, Introduction, *a L'stronomie Natique*, p. 228. For influence of Mājid's ideas on European navigation see Hubert Bird, *The Arab Navigators*, etc., (in Arabic) in *Al-Mustama' al-'Arabi*, B.B.C., London 21 August, 1943, pp. 12-13 and 18.

2. *Encyclopaedia of Islam*, Vol. IV, p. 529.

3. *Ibid.*, Sup. No. 2, pp. 70-71.

in the day, the earliest examples dating from about 1300 A.D. But the perfection found therein is difficult to account for, unless we assume a long process of evolution.[1] The majority of Western scholars, however, are of the opinion that the Portolani are unconnected with any other series of maps, medieval or classical. Perhaps some new discovery by further research may reveal the influence of Arab navigation charts on these European maps. In spite of their many fine details, the makers of these charts did not use Ptolemy's system. They neglected latitude and longitude because they were difficult to determine, hence their grid system was merely a series of lines radiating, like the spokes of a wheel, from several points on the map.

The Babylonian conception of the universe was a disc-shaped earth floating in the ocean, with the vault of heaven arching above it, and the firmament over all. This notion was accepted by the Greeks and Romans, as well as by the Israelites, and through the Scriptures it was carried over to the Christian Europe of the Middle Ages. Ptolemy marks the culmination of cartography in the ancient world. Henceforth there was a steady decline. Although the 'Geographia' continued to be available in the Arabic world, it disappeared in Western Europe and was not recovered until the fifteenth century. As a result, the Latin-Germanic culture of the Middle Ages was forced to depend for its geographical knowledge on an inferior source, the tradition of Roman cartography. Ptolemy's most

1. Jervis : *The World in Maps*, p. 69.

fundamental error was his under-estimate of the earth's size, an error which luckily helped to strengthen Columbus' belief that he would reach Asia quicker by sailing westward. Taking the figures of Posedonius (1 degree = 500 stadia) and applying them to the distance measurements at his disposal, he concluded that Europe and Asia extended over one-half the surface of the globe, while in reality they cover only about 130 degrees. Similarly, he reckoned the length of the Mediterranean as 62 degrees, whereas in reality it is only 42 degrees. "Although the Arab geographers and the marine chart-makers of the thirteenth century had corrected this distortion, it continued to figure in European cartography until 1700."[1]

On the whole, from the point of view of a distinct advance over the older works, the Muslim geographers constructed celestial globes and studied the problem of projections. Their maps of those areas which had come under Islam were superior to those of Ptolemy. And a progressive tendency was that maps were regularly used for geographical instruction in schools.

One of the earliest map-makers was Al-Khwārizmī. His 'Kitāb Ṣūrat al-Arḍ' was written in explanation of maps. It is surmised that his map was copied from a Syrian copy of Ptolemy's map. It did not show a network of latitudes and longitudes. He also made a map of the Nile. According to the view[2] which accepts Khwārizmī's participation in the scien-

1. Raisz : *General Cartography*, p. 21, See also Philby in *Rozgar-i-Naw*, p. 31.
2. Minorsky : *Ḥudūd al-'Ālam* (Barthold's Preface, x).

tific activity of Māmūn's period, he was connected with the joint production of the famous map made for the Caliph, in which no less than seventy scholars participated. Some orientalists[1] have hinted that there existed a collection of maps of some parts of Iran and a world map in pre-Abbasid times, which may be called an 'Iran Atlas'. To indicate the possibilty of such a collection, it is pointed out, that Ibn al-Faqīh mentioned a map of Dailam, made for Ḥjjāj and Balādhurī says in 'Futūḥ al-Buldān' that in support of a petition to the Caliph Al-Manṣūr a map of the canals of Baṣrah was attached.

The next stage is reached with the advent of what can well be called the 'Balkhī School.' Balkhī's Atlas contained a world map, a map of Arabia, the Indian Ocean (Baḥr Fārs), maps of the Maghrib (Morocco, Algeria, etc.), Egypt, Syria, Mediterranean (Baḥr Rūm), and about a dozen other maps of the central and eastern Islamic world. The text of his geographical work which described the various lands, divided into 'climatic' zones, was written in explanation of his maps. K. Miller in the 'Mappae Arabicae' fittingly calls it the 'Islam Atlas'. All that is lost, but Iṣṭakhrī and a little later Ibn Ḥawqal continued this method of supplementing their writings with maps which were largely based upon Balkhī's labours. But the originals of these attempts do not survive to enable us to judge fairly of their merits. Maqdisī represents the closing stages of the Balkhī school. He says, "In the making of maps we have done our best to bring out

1. Kramers : *Encyclopaedia of Islam*, Sup. No. 2, p. 65.

correct representations of the different parts of the empire after carefully studying a number of drawings . . . and also the drawings of Ibrāhīm al-Fārisī (Iṣṭakhrī), which come nearer to fact and are worthy of reliance although confused and imperfect in many places."[1] He divided the Muslim world into fourteen divisions and showed each one in a map And a proof of his more practical cartographic ideas is found in his own words: "In these maps the familiar routes have been coloured red; the golden sands, yellow; the salt seas, green; the well-known rivers, blue, and the principal mountains, drab; that the descriptions may be readily understood by everybody."[2]

Al-Bīrūnī made a round map of the world in his 'Kitāb al-Tafhīm' to illustrate the position of the seas and in another work 'Chronology of Ancient Nations,' he devised a method for the projection of maps of the sky and the earth. Idrīsī was undoubtedly a celebrated map-maker, who is said to have made seventy maps of his 'Climatic' divisions, a celestial sphere, and a globe of silver,—on the globe he indicated his seven latitudinal 'climatic' divisions. He also made a map on a silver plate. These were prepared along with other geographical works at the court of his patron, King Roger II of Sicily towards 1154 A.D. On the whole, his maps represent the Western Islamic world better than eastern. Later, the world maps of Qazwīnī and al-Wardī were perhaps designed after the world map of the 'Balkhī School'. Two celestial

1. *Maqdisi*, p. 8 (Constantinople MS).
2. *Ibid*, p. 12.

globes were made by Abdur Rahmān al-Sūfi toward 1040 A.D. in Cairo and Ibn Hula of Mawsil made his bronze globe in 1275 A.D. A round world map is found in the Constantinople MS. of Al-Kashghari's 'Dīwān Lughat al-Turk' (1333-1335 A.D.).

The valuable researches of Konrad Miller and Prince Youssouf Kamāl, with the collaboration of J.H. Kramers make it possible to arrive at a fair estimate of Muslim Cartography.[1]

1. Monumenta Cartographia.

CHAPTER VI

INFLUENCE OF MUSLIM GEOGRAPHY ON THE WEST

THE subject of the extent of the influence of Muslim Geography on the European minds is interesting. Generally, it is claimed that the development of Mediaeval European geography as well as early modern geography, was somewhate independent of Muslim contribution. This view appears to be rather traditional and out of date, as its basis is emotional and in disregard of historical and cultural processes. An able and brilliant group of European scholars, including many orientalists, through their painstaking researches into the sources of modern science have produced indisputable evidence of the transmission of Muslim scientific thought to European communities.

In the preceding pages the story of the many-sided Muslim contribution to geography has been related. It was a part and parcel of that intellectual renaissance which characterised the rise of Islamic civilization. Its growth and development is closely linked with the dawn of a new scientific spirit which so markedly set reason above authority. The Arabs' assimilation of both classical and oriental lore and their cementing by their own genius led to a remarkable quickening of the scientific impulse. They possessed a will, a mind, and a marked capacity of their own, which impressed its special stamp on all they received or borrowed

from others. This was as true of the geographical science as of other arts and sciences. This striking intellectual freedom was amazing indeed, for theirs was an age of faith and blind submission to authority. The spirit of tolerance, large outlook and craving for learning and extending the frontiers of knowledge characterised the Muslim mentality. The geographical science during these times was closely linked with cultural and scientific progress in Islamic lands, and continued to attract the attention of intelligent people, as Stanislas Guyard said, "During the Middle Ages the history of Muhammadanism is the history of civilisation itself."[1]

A view is often held that the Mongol invasion of the thirteenth century dealt a death blow to Muslim culture from which it never recovered. Thereafter, according to this view, followed a period of rapid decline, as the Arabs and the Persians had already, by this time, contributed all they could to science and culture, and their successors the Turks, were unable to produce any creative work. It has been amply[2] demonstrated by many competent modern historians and orientalists that such a picture of the Muslim world plunged in deep sleep till it was re-awakened by the Europeans in the nineteenth century is greatly exaggerated.[3] The riches and wealth, power and prestige of the Usmanlis, the Timurids, the Kajars in Persia and the Grand Mughals in India, in their times, out-

1. Zakī 'Alī : *Islam in the World*, p. 97.
2. J. Hell : *Arab Civilization*, p. 103 and many others, *i.e.*, Beazly : *Dawn of Modern Geography*, Vol. II, p. 7.
3. Barthold : *Mussalman Culture*, pp. 142-43.

shone any part of Europe.

Many modern geographers seem to attach little value to Muslim geographical contribution after the thirteenth century and generally dismiss it lightly as a sterile period. Though much of the originality of earlier writers is missing, but to say that the geographical literature ceased to contain valuable information and assumed the shape of cheap imitations, is not only to misunderstand but to ignore its content. The work at Marāghah and Samarqand was of high quality in the field of astronomical and mathematical geography. European travellers still very largely depended upon Muslim sources for their information. Marco Polo has used many geographical names in their Persian forms and speaks of the information he derived from Muslim navigation charts in Ceylon. Persian astronomical influence is traceable in China[1] and lasted up to the seventeenth century. Rashīd-ud-dīn's historico-geographical works stand out unique among contemporary contributions of both the East and West. His work provides a mine of information about Chinese borders, Mongolia and Siberia which was not forthcoming till his times. Much later than that, Ḥājī Khalīfah produced his geographical treatise 'Kashf al-Zunūn' which can be considered the first attempt to compare the data of European geographical literature with that of the Muslims. Post-Columbus Europe has no comparable contribution. Auliya Chelebi's description of travels is considered by a European scholar[2] in

1. Barthold: *Mussalman Culture*, p. 115.
2. *Ibid.*, p. 140.

its completeness and many sidedness of information far above the writings left by some of the best Arab geographers. In the domain of nautical science and information about the seas, the works of Shihāb al-Dīn and Al-Mahrī can stand comparison with the best of the specimens of the days of Prince Henry the Navigator and it took the European seamen several generations to acquaint themselves with the Indian Ocean to the same extent.

Ever since the birth of modern geography, increasing attention has been paid to the study of the history of geographical thought and the evolution of this important social science. But it is usual with many a Western writer to speak of the Muslim contribution as brilliant but a kind of 'detached' development influencing renaissance geography in Europe only indirectly.[1] It is also not unusual to find some modern geographers[2] going to the extent of completely ignoring the value of Muslim achievement and denying that the rise of Muslim culture between 700-1400 A.D. though marked by the production of gazetteers, accounts of travel and speculation concerning the function of environment in human affairs, had little or no effect on Western cartography and other aspects of geographical thinking. But many others while recognising a period of 'brilliance' (so-called Classical Age) believe in the rapid 'fall' or 'decline' of Muslim geography no sooner scholasticism raised its head in the West. The

1. Baker: *History of Geographical Discovery and Exploration*, p. 70; also Hitti: *History of the Arabs*, p. 570.

2. H. Davies: *Earth and Man*, p. 7.

remarks of Raymond Beazley[1] typify this attitude, "The outlook of Europe had greatly extended, all absorbing ambitions of the Saracens have been thwarted—in particular its geographical outlook, its knowledge of the world, both practical and scientific has been widened, and deepened, while that of its great rival is already giving signs of an autumn, which however splendid, is an autumn still. We must not be deceived by exceptions . . . The slowly dying flame blazes up once more in a brilliant farewell with the work of Ibn Baṭṭuṭa and Abu'l Fidā; but after this there is little but cold and darkness." As a matter of fact the continuity of Muslim culture, the production of geographical works and the limitations of renaissance geography in Europe till the very advent of the Age of Discovery[2] tell a different story. The too often repeated thesis that geographical thought of the renaissance mainly grew out of the 'back to Greek works' cry, the broader implications of the 'Age of Crusades' as distinguished from the contact with the world of Islam during the Crusades, and the fall of Constantinople giving impetus to learning, should not be unduly exaggerated. This tendency leads to a distorted view of the history of world culture and encourages an unscientific belief in the absolute isolation of cultures; bestowing an air of uniqueness to all renaissance thought in Europe. Therefore, it is desirable to evaluate properly the merits of Muslim geography in the evolution of geography as such, and not to treat

1. R. Beazley : *Dawn of Modern Geography*, Vol. II, p. 7.
2. *Ibid.*, p. 8.

the subject merely as a special interest of orientalists.

The survey which has been undertaken in the above pages amply supports the view that cultural growth has not come about in watertight compartments. It is a story of wide contacts, actions and reactions. The renaissance of Western Europe in the Crusading Age was fully as much an intellectual, as a material and political movement. Science was at last touched and changed by the new life as completely as the arts of war, travel, trade and missionary enterprise. And among other branches of science none made greater progress than geography.[1]

There were several sources of the transmission of Muslim Science and geography to Latin Europe and the West. These points of cultural and physical contact were in Spain, Italy, Sicily and some of the Aegean islands. During the prolonged struggle of the Crusades there was a constant contact between the two cultural worlds. As the earlier translation activity at Baghdād had paved the way for a new synthesis, in a like manner, the numerous translations of Arabic works in Spain, Italy and Sicily were once again helpful in advancing scientific thought.

Latin geography before the early twelfth century was much inferior to that of the Muslims. It was too simple and almost childish. This remark especially applies to those writers who were not influenced by Arab ideas and continued to follow the Roman and early mediaeval traditions, *e.g.*, Henry of Mayence,

1. R. Beazley : *Dawn of Modern Geography*, Vol. II, p. 8.

Guido and Lambert of Saint Omer. On the other hand, those who showed somewhat better geographical sense like Hermanm the Dalmatian, Bernard Silvester and William of Conches had been influenced by Arab ideas.

A substantial part of Greek science was gradually translated into Arabic and by the beginning of the twelfth century, the main achievements of Greek knowledge were available in Greek and Arabic. For Latin scholars, the Arabic translations were more accessible than the Greek originals. The originals were either forgotten or lost in most cases. The Arabic civilization had geographical contact with Mediaeval Europe at several points including Spain, Sicily and Mediterranean Asia. The Arabic speaking people culturally dominated the peripheries of the Mediterranean Sea, had the leadership in Asiatic trade and probed far into the African continent.

Thus, whenever the West felt the need of deeper and fresh knowledge it invariably turned to the Arabic sources. Therefore, the main intellectual task of the twelfth and thirteenth centuries was one of translation. A vast amount. of Scientific literature including geographical material was translated from the Arabic into Latin and the translators belonged to many parts of Europe.

For example, Walcher of Malvern, Adelard of Bath, Robert of Chester and Michael Scot were English; Hermann hailed from Dalmatia; Rudolf of Bruges and Henry Bate came from Flanders. Armen-

gaud, Jacob Anatoli, Moses ibn Tibbon, Jacob ben Mahir were French; Plato of Tivoli, Gerard of Cremona, Aristippus of Catonia, Salio of Padua and John of Brescia belonged to Italy; and then there were several Spaniards including John of Seville, Hugh of Santala, and Marc of Toledo. The bulk of translations were from Arabic into Latin, Arabic into Hebrew and to Latin, Arabic into Greek and then to Latin and Arabic into Latin and subsequently into Hebrew.

There was no branch of learning, science or geography which did not attract the translators' attention. It was quite natural that even when geographical works were not specifically translated, the ideas contained in them were copied into other writings.[1] It is not necessary to focus attention on individual works or their translators. The fall of the great city of Toledo (1085 A.D.) one of the best Muslim intellectual centres in the west, opened the gates of knowledge to Christendom. As soon as the dust of warfare had settled down, eager students from Europe began to come there to study the 'Artes Arabum.' The Jews, Christians and Mozarabs mingled here in a unique collaboration of learning which created a scientific synthesis for the West. The scientific and translation activity at Toledo during the succeeding generations of the twelfth century was indeed remniscent of 'Bait al-Ḥikmah' (Translation Bureau) era in Abbasid Baghdād three centuries earlier.

King Alfonso evinced deep interest in Arab science

1. Beazley : *Dawn of Modern Geography*, Vol II, p 8.

by establishing a school of translation under the direction of the Archbishop of Toledo and under the supervision of Archdeacon Dominico Gondislavi. The Hebrew scholar Johannes ben David was an active collaborator and in 20 years a large number of works on science and philosophy were translated. Gerard of Cremona was an outstanding translator and during his long residence in Spain produced about eighty-seven translations. He can undoubtedly be regarded as the father of Arabism in Europe. The first comprehensive translation of the *Almagest* was completed by Gerard at Toledo in 1175. Indeed it was through this translation from the Arabic that the *Almagest* was first transmitted to the West. He also translated, among other works Banū Mūsa's contributions, and several writings of al-Khwārizmī, al-Farghānī, al-Nairīzī, Thābit b. Qurra, al-Bīrūnī's commentary on Khwārizmī, and tables of Jābir ibn Aflāh and Zarqalī.

Many European scholars settled down in several cities of northern Spain, namely, Taragona, Leon, Segovia, Pamplona, etc. The Spanish-Arabic learning permeated all the West and the intellectual avenue leading from the portals of Toledo through the Pyrenees wound its way through Provence and the Alpine passes into Lorraine, Germany and Central Europe, as well as across the Channel into England. Earlier, Constantino Africano travelled for 30 years in Muslim Africa and the Orient and settling down at the Benedictine monastry at Monte Cassino near Salerno, transtated many Arabic works. Sicily was another scene of the intermingling of Christian and Arab cultures

IDRISI'S WORLD MAP
(C. 1154, A.D.)



5 Facing p. 141.

and these peaceful interchanges were productive of geograpical literature which was rich with the new knowledge of Africa beyond the Sahara and the epoch-making contribution of the great geographer al-Idrīsī. All these scholarly exchanges were considerable and exerted a profound and far reaching influence on scholasticism and renaissance geography in Europe. Indeed, translations continued even into the sixteenth century. Translations of these later dates were current in the Universities of Europe, particularly in Northern France and Italy.

The major proportion of European geographical writings of the twelfth century consists of Latin and other Christian pilgrim literature. Wurzburg was a German pilgrim in the late twelfth century, Joannes Phocas was a soldier turned monk who wrote of castles and cities from Antioch to Jerusalem and Ridhard Coer de Lion was a crusader king. Sigurd was king of Norway who turned a fanatic crusader and made a remarkable journey to Palestine and back between 1107 and 1111 A.D. The outward journey was a fighting cruise through the North Sea, the Mediterranean and the Aegean waters. He fought Muslims around Spain and visited the cultured court of Roger II of Sicily, before his return home by an overland route through Europe. His saga is somewhat geographical in its content and bears traces of contact with the Orient.

Pedro Alfonso made a sketch map of the world clearly derived from Muslim models, copying the seven climates and putting the south on the top. Henry

Mayence compiled a treatise in 1110 A.D. which included a map. A geographic encyclopaedia was written in 1119 A.D. by Guido who was probably an Italian geographer. Lambert of Saint Omer wrote another encyclopaedia in which he propounded his belief in the rotundity of the earth and added maps to his manuscript. Hermann the Dalmatian wrote his cosmographical compilations in 1143 A D. which included astronomical and geographical information and Bernard Sylvester produced his 'De mundi'

Nearly all of the above named writers as well as other contemporaries who delineated on geographical matters were steeped in patristic and Latin traditions. But by the middle of the thirteenth centnry a distinct change was perceptible, as by that time, the full impact of the translations was evident in the more readily available Arab knowledge in Europe. Scholars were not only aware of it but were beginning to feel the need of it. The new knowledge of which the Muslim geographical information and notions were an indispensable part, began to work as a great stimulus to new ideas in the Latin World.

As a result of all this, the level of geographic thinking and writing in the West was definitely raised. Vincent of Beauvais, Albert the Great and Roger Bacon and others were all sufficiently influenced by Arab knowledge of geography and its associated fields.[1] Joannes Sacrobosco (John of Hollywood) the English astronomer and mathematician wrote his 'Sphaera

1. Geiki : *Founders of Geology*, p. 43.

mundi' in 1233 A.D. This work was very much based upon al-Farghānī and al-Baṭṭānī and it became immensely popular in the West and went into several translations and remained in use upon the seventeenth century. About the same time, William the Englishman in 1231 A.D., mainly interpreted al-Zarqalı and al-Biṭrūjī. Vincent of Beauvais the French Dominican scholar who died in 1264 A.D. compiled an Encyclopaedia. He was labrarian and tutor of Louis IX. It was a monumental work and much of its geographic and geological information is derived from Arab sources. Albert the Great who died in 1280 A.D. was another outstanding Dominican intellectual and a prolific writer. He kew neither Greek nor Arabic but acquired a vast learning through the medium of Latin and had seriously studied Muslim thought and was considerably influenced by their geographical ideas. Roger Bacon's 'Opus Majus' is replete in its geographical references[1] to Arab sources. Gossuin of Metz or Walters' 'Image du monde' written about 1246 A.D. was derived from existing sources heavily tinged with Muslim knowledge. Konungs Skuggsja is an outstanding geographical and encyclopaedic treatise written in old Norwegian by an unknown author between 1217 and 1260 or 1247 (circa). The author was either a priest or court chaplain and a good deal of his material is based upon the accounts of crusaders and pilgrims who had returned. It displays good geographical sense, particularly in physical geography. He believed in the spherical earth. The work is not entirely without Arab influence. The travel accounts of

1. Roger Bacon : *Opus Majus*, Vol. I, p. 318.

the Englishman Sir John Mendeville though verging on the fantastic are a rehashing of common Arab knowledge in geography.

Throughout the Middle Ages, it seems, there existed a close relation between navigation and cartography. It is generally supposed that throughout this period the open ocean inspired a great fear in mariners and sailors, perhaps largely due to the lack of proper instruments to fix their positions. That ships were small, no bigger than barges and therefore unseaworthy, is taken for granted. It was only after the invention of the compass that bigger ships came into being. Such suppositions are not borne out by a study of Arab navigation.[1] For centuries before Columbus crossed the Atlantic to search for Paradise to the south-west and also India; the Indian Ocean stretching all the way from the Arabian and African coasts to South-east Asia had become the beaten track of Arab sailors. On these seas apart from small coastal vessels, also sailed huge craft carrying no less than a thousand persons. Towards the close of the tenth century A.D. Mas'ūdī speaks of the prototypes of modern shipping companies with large ships. The mysteries of the Atlantic were certainly not very seriously probed into by Muslims beyond a few attempts which brought them the knowledge of the Azores and the Canaries, etc., (*vide* Ibn Sa'īd and Idrīsī). There were reasons for that. Their ideas of the sphericity of the earth (without the knowledge of

1. See Carrade Vaux: *Les Penseur de l'Islam*, Chap. I, Vol. I. Also *vide* Buzurg ibn Shahriyār and Mas'ūdī.

the existence of the Americas) brought to their mind the idea of reaching South-East Asia and China by a westward sailing. But the question would have been, was it worth the trouble to face the risk of sailing into the unknown waters of Baḥr Muḥīṭ or Zulmāt (Atlantic Ocean) when they could contact these lands easily *via* the Indian Ocean? The Muslim world of the Maghrib (Morocco and Algeria, etc.) and Andulus (Iberian Peninsula) ought to have been more interested in the Atlantic sailings. But their case was different from the problem facing the European sailors. To them the contact with India and a share in the Far Eastern and Chinese trade was assured through the Muslim 'Sea-lanes' of the Mediterranean and Indian Ocean and the Overland routes to the confines of China and beyond. The East lived in the imagination of the fifteenth century European sailors and navigators and provided an incentive to 'sail west' aided by Ptolemy's underestimates of the earth's circumference and the search for Paradise.

The main cartographical achievement of the Middle Ages, however was not the ability of the makers of *mappae mundi* but the creation of portolani or sailing charts. Their origin is mysterious. But their appearance was attendant on the need that was felt in widely-separated areas as a result of extensive maritime activity. In the Arabic world, their origin is certainly connected with extensive sailings over the open stretches of the Indian Ocean and the Far East as well as the appearance of many professional pilots,[1]

1. G. Fernand : Introduction *L'astronomie Naṭique Arabe*, p. 225.

the so-called 'Lions of the Sea, (*i e*. Muḥammad b. Shādhān Sahl b. Abān and Laith b. Kahlān, etc.) who are mentioned by Aḥmad ibn Mājid[1] the great navigator of the late fifteenth century A.D. Even Maqdisī writing as early as the late tenth century A.D. while speaking of his extensive sailings over most of the known waters of the Indian Ocean, wrote, "I was thus thrown in the company of men shipmasters, pilots, mathematicians (a lacuna in the edited text; the word reads like ریاضیین mathematicians) agents and merchants who had spent a life-time on these waters, possessed the clearest and fullest knowledge of this sea, its anchorages, its winds and its lands. I plied them with questions concerning its position, physical peculiarities and its limits. I have also seen in their possession charts and sailing directories which they constantly study and follow with implicit confidence. From these sources, therefore, I have drawn, with careful discrimination and close attention, a sufficient account embodying the best information I could acquire which I afterwards compared with the charts already spoken of[2] . . ."

The continued use of such charts is further confirmed by the observation of Marco Polo[3] who confessed that he derived his knowledge of the Ceylonese Coast and seas around from the charts of mariners of these seas. Ramon Lull also mentioned the carrying of the compass and the charts. Though there may

1. *Vide* Chap. III. 2. Maqdisī: *Aḥsan al-Taqāsīm*, p. 14.
3 Yule and Cordier: *The Book of Ser Marco Polo, op. cit.*, Vol. II, pp. 312-13.

not have been a multiple production of such charts and the element of secrecy may have been there, yet their wide use is established beyond doubt. No traces of these charts have so far been discovered, but it would not be surprising if some time in the future copies may see the light of day.[1] The Arab sailors continued to use their charts, and instruments and their high value even when it was long past the Age of Discovery was realised by Europeans. Sir Thomas Roe speaking in 1615 said that in Madagascar he met Mu'allim Ibrāhīm, who corrected his card.[2] An European historian justly remarks, "The Arabs at that time (15th century), knew the use of the compass, and had sea-charts and maps wherein the situation of the countries were laid down with great accuracy; nor were they without quadrants, with which they took the altitude of the sun and the latitude of places. In short, so great was their skill in these arts, that they seemed to be very little inferior to the Portuguese pilots, in knowledge of maritime affairs."[3]

The European portolani are first mentioned in connection with a crusade[4] in 1270. And it is generally

1. I am told on the authority of my colleague, Mr. Sulṭānul 'Ālam, Lecturer in Arabic at the Calcutta University, that in his home district, Chittagong, among some families of the Arakan Coast is reported the possession of very old sailing charts which are regarded as a precious ancestoral heritage and are never shown to strangers. The war has left a deep scar along the Arakan Coast and life has been greatly disrupted. No one knows the value of the above-mentioned charts but the knowledge of some specimen may lead to a discovery of first-rate importance.

2. G. Fernand: Introduction, *L'astronomie Natique Arabe*, p. 236.

3. *Ibid.*, quoting from J. Gibbs: *History of the Portuguese during the Reign of Emmanuel*, Vol. I, p. 53

4. Dickinson and Howarth: *The Making of Geography*, p. 62.

accepted that they had a long process of evolution, Carte Pisan (c. 1300) being the earliest extant example. The portolani charts were first made in the flourishing cities of Northern Italy and then along the Catalan Coast, culminating in the best example, *i.e.*, the Catalan Atlas of 1375. But it is thought that even the earliest Carte Pisan, which is a crude attempt, appears to be a copy of an older chart or series of charts.[1] It is said that the Catalan Map of 1375 represents the most complete mediaeval embodiment of Polo's Geography and it is for the first time, apart from the correct position of China, that the Indian Peninsula is shown with some approximation. But according to Peschel,[2] Al-Bīrūnī had already made such a chart. Though it is true that several things in the map show Polo's information but there are many place names and areas, it is pointed out, which the Venetian does not mention, *i.e.*, Delli (Delhi) Deogil (Deogir), Cambetum (Kambayat-Cambay) Baroche (Baruch) Neruala (Anhilwara) and portions of China, Turkistan and Siberia. Obviously the source for these was Muslim geography. It has so far not been possible to establish a clear relationship between the European portolani and the earlier Arabian attempts (none of which now seem to have survived). But enough has been said to show that the Western models may not have been an entirely new thing (as is commonly supposed) without a degree of influence from the earlier and widespread Muslim specimens as well as their geographical writings.

1. Jervis : *The World in Maps*, p. 71.
2. Yule and Cordier : *The Book of Ser Marco Polo*, Vol. I, p. 134.

The next stage in medieval European map-making is marked by the synthesis between the portolani charts and the practical navigationalexperience acquired under the guidance of Prince Henry the Navigator. Henry's earliest struggles against the Muslims in North Africa, near Ceuta, when he was only 21 years of age (1415 A.D.) had excited his interest in the extensive knowledge of the world possessed by his enemies. He gleaned much valuable information from the Muslims at Ceuta, concerning such regions as interior of Africa and of the trade carried on with the interior possibly, as far as the Guinea Coast.[1] On return home and becoming the ruler of his kingdom he became a patron of learning, and geography and navigation interested him most. He provided instruction in cartography and astronomy, including the use of appropriate instruments and is said to have chosen his teachers with a commendable disregard of political sentiment although he was a religious bigot. Some of his mathematicians were Arabs.[2] The result of this many-sided synthesis after the times of Henry is evident in the maps of the fifteenth century which followed. The problem of reconciling traditional hotch-potch of world knowledge with results of practical observation and wide range of information from Muslim sources became acute and this kind of confusion is particularly witnessed in (otherwise one of the outstanding efforts of these times) Fra Maura's map (1459) which shows less accuracy than the Catalan map. For parts of Africa, *i.e.*, Abyssinia, he knits Polo's accounts into

1. Keane: *The Evolution of Geography*, p. 84.
2 Dickinson and Howarth: *The Making of Geography*, p. 72.

Arab conceptions and makes them fit together. The other three examples, the Este, the Walsperger and the Genoese maps, all of approximately the same date (c. 1450), show an unmistakably strong Arab influence. Commenting upon the Este map a modern scholar says,[1] "of these influences the Arab is strong, while it is improbable that the classical influence is direct. Thus the map owes nothing to Ptolemy and it is less likely that its author should have taken his ideas of a southern continent direct from Crates, the originator of the concept, than that he should have taken it from Arab or Christian cosmographers, such as Abu'l Fidā or Isidore who revived it. The influence of the mediaeval Christian tradition is betrayed in such things as the legend relating to Prester John and the portrayal of the Terrestrial Paradise. There can be no mistaking the Arab influence. One has only to compare the delineation of the southern half of Africa on the map with the description given by the eleventh century writer, Al-Bīrūnī, of the shores of the Southern Ocean to be convinced of the kinship"[2] In Fra Maura's map can be recognised such Arabic names as Abasia (Ḥabsh-Ḥabshah) and Saylān (Ceylon) and in Martin Behain's globe (14 2) one may also read Moabar (Ma'bar Coromandel Coast).

The spirit of rejection of material from Arabic or even Christian travel literature, including that of

1. Kimble : *Geography in the Middle Ages*, p. 197.

2. For 'the countries beyond the Equator with winter instead of our summers' see Ahmad Zaki Validi's *Al-Birūni's Weltbild* as well as the *Pharmacology of Al-Birūni*, Brusa, MS. as suggested by Validi. Also Yāqūt's *Mu'jem-al-Udaba*, Vol. VI. p 310

Marco Polo, as against Church views and out-of-date Ptolemaic knowledge, was so strong that even after the commencement of the Age of Discovery, Europeans went on rejecting the proven facts of earlier information. No wonder then that specific mention of information derived from Arabic sources is not often made. Such information was certainly available, though it was not displayed in its entirety on maps and incorporated in texts by proper acknowledgment. But it helped to increase the confusion in mediaeval European geography between the real and unreal which lasted till the sixteenth century and produced "a most extraordinary hotch-potch conveying no approximation to any consistent representation of facts."[1] Evidence of this is found in the maps of Mercator (1587), Magini (1597) ect. Even in Sanson's map (1659) though the data of Polo and mediaeval travellers is more cautiously handled, yet a new element of confusion is introduced in the form of numerous features derived from Idrīsī (*vide* Tr. published in Rome, 1526).

DESCRIPTIVE AND REGIONAL GEOGRAPHY

It is generally believed that it was mostly in the astronomico-mathematical and cartographic fields that late mediaeval and renaissance geography in Europe, was partly influenced by Muslim geography and, what may be called, literary Islamic geography left no direct impression on European mediaeval thought, as the works of these geographers found no translators

1. Yule and Cordier: *The Book of Ser Marco Polo*, Vol. I, p. 136.

into Latin.[1] But in these pages we have briefly surveyed the many-sided contact between the lands of Islam and Christian Europe, which is manifested in trade and commercial activity, transmission of social habits and cultural attitudes and a widespread intellectual activity. Therefore, the enlightened minds in Europe could not be wholly unaware of Muslim achievements in the field of descriptive and analytical geography. By the time the Crusades came, the Arab enterprise had extended to commercial relations much beyond the limits of Ptolemy's world. In the contact of the East and West during and after the Crusades, the whole of Europe profited. It was in the general raising of the standard of life following the Crusades that men's mental horizon became enlarged and the riches of the East, its gold, silks, jewels, spices and works of art became familiar throughout Christendom. The conception of a 'world summit' known as Arin, derived from the Hindu sources, was an important point in all Arabic system It found its way from Arabic sources into the 'Opus Majus' of Roger Bacon and later into the 'Image du Monde, of Cardinal Pierre d'Ailly, from whence Columbus derived his notion of another world summit 'over against the mouth of the Orinoco', as he wrote to his patroness, Queen Isabella [2]

With the news of the spectacular rise of the Tartars from the grasslands of Central Asia, the Popes were obsessed with the idea of converting these heathen nomads to Christianity and to harness their

1. Hitti : *History of the Arabs*, p. 387.
2. Keane : *Evoluiton of Geography*, p 48.

zeal to crush Islam Thus were sent priestly ambassadors, the Friar John de Plano Carpini in 1245 and the Friar William de Rubruquis (July 1253). Then came Marco Polo's journeys (1271) and the Friar Odoric went East in 1318. Of these, the earlier friars were more interested in their religious mission, rather than geographical information, though some of their observations found place in European writings. Odoric practically added nothing to geographical knowledge. Polo contributed a great deal of new facts to the knowledge of the earth's surface already possessed by mediaeval Europe. The European mind still remained suffused with religious obscuranticism which clogged geography as well as other branches of science and human knowledge. Two things exercised a tremendous weight on mediaeval European mind, the pseudo-geographical conceptions of Christian Fathers and the numerous out-of-date ideas of classical geographers, *i e.* Strabo, Ptolemy, etc. Anything which cut across these ideas though based upon actual observation was not easily accepted, nay, at times, vehemently opposed and ridiculed.[1] Thus is explained the apparent non-acceptance of some aspects of Arab knowledge of the world, but in spite of this reluctance, there is a consistent indirect reference to those sources in the geographical and semi-geographical works of European origin.

The Dominican Friar Vincent of Beauvais (c. 1250) the writer of the biblical ridden compendium of knowledge, the 'Speculum,' when speaking of the Nile

1. Yule and Cordier: *The Book of Ser Marco Polo*, Vol I, p 130

valley cites Ibn Sīnā among his authorities. In the writings of Friar Albert the Great, who often shows variance from the orthodox view of the world, are found traces of knowledge about the interior of Africa and the lands beyond the torrid zone, acquired from many Arabic sources. Next come the imaginary travels of the Englishman, Sir John Mandeville (c. 1356). These accounts are regarded as purely fictitious, filled with legends and fables, gleaned from other writers or from mere hearsay. There is found a revival of all old myths from Solinus, Pliny and Oderic and they have been cleverly intermixed with knowledge derived from the Arabic sources. The Book gained immense popularity during the fourteenth and fifteenth centuries. It gives the European layman's idea of the world. The circumference of the earth is given as 20,425 miles after the Arab sources.[1] The writer's assertion of personal travel to lands beyond the equator, observances of the Antarctic Star instead of the Arctic and the suggestion that there must be more habitable lands to the South and the East than was commonly supposed, throws an important light upon the contrast that existed between the accepted facts about the world in that direction, in the West, and the matter of more common knowledge in the lands of Islam. The above instance may very well point to the influence of Muslim knowledge of the geography of the world (*vide* Mas'ūdī, Al-Bīrūnī, Idrīsī and many others). Such accounts were certainly of consequence in their impact upon the minds steeped in tradition and

1. Compare with Farghānī's 20,428 miles given by Roger Bacon: *Opus Majus*, Vol. I, p. 249.

provided a stimulus to consider facts about the earth based upon observation and experience. Cardinal Pierre d'Ailly's 'Tractatus Imagine Mundi', written 140 years after Roger Bacon, is on the other hand, oblivious of contemporary exploration and travel and as has been well said, "The whole work with the exception of a few Arabic citations, mainly from Latin translations of the works of Ibn Sīnā and Ibn Rushd might have been composed a thousand years previously.[1] Thus continued the zigzag course of early renaissance geography.

Knowledge of many parts of Africa, *i.e.*, the Sahara, Sudan (Ghanā, parts of Guinea Coast, Senegal and Niger) was mainly derived from Muslim sources. The information was based upon a highly-developed trade and commercial activity with these lands. The Muslims of North Africa knew of the riches of these areas and through them the knowledge of these was passed on to the Southern Mediterranean lands of Europe. The people of the West learnt from them of the great value of this trade and the mineral wealth of the West Coast of Africa. In the next period we find the great outburst of Portuguese maritime activity preceding the rounding of the Cape of Good Hope. Among the reasons for this quest, apart from the religious zeal of joining hands with the mythical Prester John (a desire stimulated by the final defeat of the Crusades) and the desire to reach the Far Eastern seas, was also the hope of immediate gain from the trade and gold of the Guinea Coast derived from the knowledge emanating from Muslim descriptions.

1. Kimble: *Geography in the Middle Ages*, p. 209.

As has already been pointed out, Arab attainments in the domain of physiography were of a high standard as interesting light was thrown on the understanding of the processes of denudation, earthquakes, orogenics, tectonics and even continental drift. The writers of the treatises of the 'Ikhwān as-Ṣafa', 'Ibn Sīnā' and 'Al-Bīrūnī' often took up these matters. Europe, it seems, did not remain entirely ignorant of these progressive views. For instance,[1] in a translation of a work of Ibn Sīnā by a certain Alfred of Sareshel, views were put forth regarding the origin of mountains and valleys which would be interesting to many modern geographers. Rivers, their work in general, and the regime of the Nile floods were studied by several writers and reached Europe through the works of Benjamin of Tudela andLeoAfricanus among others. Thus here and there and in multiple ways, Arab geographical ideas continued to reach Europe throughout the centuries when the West lived under a shadow of ignorance of science.

Thus, gradually much of the basic and current geographical concepts and ideas of the Muslims were passed on to the West. These were with regard to the size of the earth, its rotundity, Oceans, geological processes, climate, vegetational and zoological distributions, knowledge of new lands in Africa, Far East ahd Central Asia and techniques of cartography and uses of instruments.[2] All this knowledge in various degrees

1. Kimble : *Ceography in the Middle Ages*, p. 169 : also Geiki : *Founders of Geology*, p. 43.

2. G. Ferrand : *Int. L'ast, Natiq. Arabe*. p. 225.

of assimilation is depicted in the leading geographical works and also formed the background of the so-called 'mappae mundi', and some of the maps of later generations preceding the Columbian era, *i e.*, the 'Pslater map' (c. 1200), 'Hereferd map, (c 1280), the world map of Marino Sanuto (1321), the 'Borgian World map' (1450), 'Este World map'[1] (c. 1450), Fra Maura's 'Africa' (1459) and the diagrams of 'Image du Monde' (1480). Though these maps were much removed from reality and mirrored the shadows of patristic and traditional notions, yet acquaintance with Arab cartography and geographic information is revealed in them.[2]

On the whole, the twelfth, thirteenth, fourteenth and fifteenth centuries, were a period of transition and compromise, a time of absorption and fusion, because it was then that the conflicting Muslim and Christian cultures were brought most closely together. The result was the creation of the core of new Europe. This was essentially Greco-Arabic-Latin. After the invention of the art of printing, in the second half of the fifteenth century, many Greco-Arabic scientific works were eagerly and repeatedly printed. In fact, the influence of Arab science remained paramount in Europe, till Copernicus published his revolutionary concepts and the beginning of experimental science emerged towards the middle of the sixteenth century. But Arab science, as a factor in European thinking, lingered on much longer, almost upto the birth of the scientific method and the eve of the Industrial Revolution.

1. Kimble: *Geography in the Middle Ages,* p. 197.
2. Keane: *Evolution of Geography,* p. 48.

BIBLIOGRAPHY

TEXTS AND SOME TRANSLATIONS

Abu'l Faraj Qudāmah ... Kitāb al-Kharāj in Bibleoteca Geographorum Arabicorum, pt. VI, Ed. M. J. de Goeje, Leiden, 1870-94.

Abu'l Faḍl 'Allāmī ... Ā'īn-i-Akbarī, English trans. H. S. Jarrett, Calcutta, 1894.

Abu'l Fidā ... Taqwīm al-Buldān — Geographie d'Aboulfeda (French text and commentary by J. T. Reinaud), Paris, 1848.

Al-Balādhurī ... Futūḥ al-Buldān, trans. P.K. Hitti, 2 Vols. New York, 1916.

Al Balkhī ... Ṣuwarah al-Aqālīm (Figures of Climate) Ed. and trans Le Strange and Nicholson, Cambridge, 1921.

Al-Bīrūnī ... Kitāb al-Hind (Al-Bīrūnī's India) trans. E. Sachau, Kegan Paul, London, 1914.

,, ... Chapter on Pearls in the 'Book on Precious Stones', trans. F. Krenkow, *Islamic Culture*, Hyderabad, Vol. XV, 1941.

Al-Iṣṭakhrī ... Kitāb al-Masālik wal Mamālik (abridged Oriental Geography), trans. Sir W. Ousley, London, 1800.

Bacon, R. ... Opus Majus, trans. R. B. Burke, 2 Vols. Philadelphia, 1928.

Buzurg Ibn Shahryār ... Kitāb 'Ajā'ib al-Hind (Liure Des Merveilles de L'Inde) Par Van der Lith, P.A. Traduction Francais, Par L. Marcel Devie, Leiden, E.J. Brill, 1883-86.

Cosmas, I ... Christian Topography, trans. Mc Crindle, (Hakluyt Society), 1897.

Ḥamdullah Musṭawfī ... Nuzhat al-Qulūb, Eng. trans G. Le Strange, Gibb Memorial Series, London, 1919.

Ḥudūd al-Ālam (Anon) ... The Regions of the World, Ed. and trans. V. Minorsky, London, 1937.

Ibn al-Balkhī Fārs Nāmah, trans. G. Le Strange, London, 1912.

Ibn al-Qiftī ... Tārīkh al-Ḥukumā', Ed. Julius Lippert, Leipzig, 1903.

Ibn Baṭṭūṭa ... Travels in Asia and Africa, trans. H. A. R. Gibb, London, 1929.

Ibn Jubair ... Riḥlat Ibn Jubair (Travels) Ed. de Goeje, Gibb Memorial Series, London, 1907.

Ibn Khaldūn ... Muqaddamah (Prolegomena).

Ibn Khurdādhbih Kitāb al-Masālik wal Mamālik, in Bibleoteca Geographorum Arabicorum, Pt. VI, Ed. M. J. de Goeje, Leiden, 1889.

Maqdisī (Al-Muqaddisī) ... Aḥsan al-Taqāsīm fi Ma'arfatil Aqālīm (Best of Divisions for the Study of Climate) Eng. trans. Ranking and Azoo, Calcutta, 1897-1910.

Mas'ūdī	...	Marūj al-Dhahab (Meadows of Gold and Mines of Precious Stones) Baghdād. Also Eng. trans. (unfinished) A. Sprenger, London, 1841.
Razī, Amīn Aḥmad	...	Haft Iqlīm, Eng. trans. 'Abdul-Maqtadir and Maḥfūz al-Ḥaq, Calcutta, 1918-1939.
Sulaimān Tājir and Abu Zaid Sīrafī		Akhbār al-Sin wal Hind (*Voyage du Marchand Arabe*, etc,) with remarks by G. Ferrand, Paris, 1922.
Yaqūt al-Ḥamavī	...	Mu'jam al-Buldān, Edited by F. Wustenfeld, 6 Vols., Leipzig, 1924.
,,	...	Mu'jam al-Udaba, Ed. Margoliouth, Gibb Memorial Series, 1913.
Zain Uddīn Shaikh (al-Ma'barī)	...	Tuḥfat al-Mujāhidīn, Eng trans. M. Ḥusain Nainar, Madras, 1942. Also Eng. trans. M. J. Rowlandson, London, 1833.

BIBLIOGRAPHY

(GENERAL)

Aḥmad, Nafīs ... Muslim Contribution to Geography during the Middle Ages, *Islamic Culture*, Hyderabad, July, 1943.

,, ... Muslim Contributions to Astronomical and Mathematical Geography, *Islamic Culture*, Hyderabad, April, 1944.

,, ... Al-Bīrūnī's Geography of India, *The Calcutta Geographical Review*, March and December, 1943.

,, ... The Arab's Knowledge of Ceylon, *Islamic Culture*, Hyderabad, July, 1945.

Aḥmad Zakī Valīdī ... Islam and the Science of Geography, *Islamic Culture*, Hyderabad, October, 1934.

Aḥmad, Ziā Uddīn ... Speech in the 'Mathematics Student,' Vol. X, No. 1, 1942.

Arnold, T., Kt. and Guillaume, A. The Legacy of Islam, Oxford, 1931.

Baker, J.L.N. A History of Geographical Discovery and Exploration, Harrap, 1937.

Barnī, Ziā Uddīn ... Al-Bīrūnī (in Urdu) Aligarh, 1927.

Barthold, W. ... Mussalman Culture, Eng. trans. by Shahid Suhrawardy, Calcutta, 1934.

Beazley, Sir Raymond ... The Dawn of Modern Geography, 3 Vols., 1897-1906, London.

Bird Hubert ... ArabNavigators, Mutama'al-'Arabī, 21 August, 1934, B.B.C. London.

Brockelmann, C. Geschichte d. Arabischen Literature, 2 Vols., Weimar, 1898-1902. Also supplement.

Burton, H.E. ... Discovery of the Ancient World, Camb. 1932.

Carra de Vaux Les Penseurs de l'Islam, 5 Vols., Paris, 1921-26.

Cunningham, Sir A. Ancient Geography of India, Ed. Majumdar, S. Calcutta, 1924.

Darby, H.C. .... A note on an Early Treatise on the Astrolabe, *Geographical Journal*, No. 2, February, 1935.

Datta, B. and Singh, A.N. History of Hindu Mathematics, Lahore, 1935.

Dickinson, R.E. and Howarth, O.J.R. .... The Making of Geography, Oxford, 1933.

Donaldson ... The Uses of the Astrolabe, *Islamic Culture*, Hyderabad, January, 1945.

Elliot, Sir H.M. and Dawson, J. ... The History of India, etc., Vol. I, London, 1867.

Enan, 'Abdullah Ibn Khaldun, Muḥammad Ashraf, Lahore, 1941.

Encyclopaedia Britannica 13th Edition.

Encyclopaedia of Islam 4 Vols. London, 1927. Also supplement, 1936.

Ferrand, G. ... Introduction aL'astronomic Natique Arabe, Paris, 1928.

Gibbon, E. ... Decline and Fall of the Roman Empire, Vol. III, London, 1900.

Ḥakīm, 'Atāul History of Arab Mathematics (Thesis under publication), Calcutta 1944.

Hell, J. ... The Arab Civilization, Trans. Khudā Bakhsh, 2nd Ed. Sh. Muḥammad Ashraf, Lahore, 1943.

Hitti, P.K. ... A History of the Arabs, London, 1937.

Hozayen, A. ... Some Arab Contributions to Geography, (*Geography Magazine*) October, 1932.

Huart, C. ... History of Arabic Literature, Heinemann, London, 1903.

'Ināyatullah, Shaikh Geographical Factors in Arabian Life and History, Sh. Muḥammad Ashraf, Lahore, 1942.

Jervis, W.W. The World in Maps, Philips, London, 1936.

Jurjī Zaidān ... 'Ulūm-i-'Arab, trans. in Urdu, Aslam Jairājpurī, Aligarh 1907.

Keane, J. ... The Evolution of Geography, Edward Stanford, London, 1899.

Kimble, G.H.T. ... Geography in the Middle Ages, Methuen, London, 1938

Le Strange, G. Lands of the Eastern Caliphate, Cambridge University Press, 1905.

Le Strange, G. Baghdād during the Abbasid Caliphate, Oxford, 1924.

" ... Palestine Under Muslim Rule (A.P Watt), London, 1890.

Levy, R. ... Sociology of Islam, Vol., II (H. Spencer Trustees) London, 1938.

Mez, A. ... Die Renaissance des Islams, Heidelberg, 192?. Also trans. by Khudā Bakhsh, Sh. Muḥammad Ashraf, Lahore, 1937.

Meyerhof, Max ... Transmission of Science to the Arabs, *Islamic Culture*, Hyderabad, Vol. XI, 1937.

" ... Article on Aconite from Al-Bīrūnī's Kitāb al-Saydāna, *Islamic Culture*, No. 4, October, 1945.

Nainar, M H. Arab's Knowledge of South India, Madras University, 1942.

Nadvī, Sulaimān, Maulānā ... 'Arab-o-Hind ke Ta'alluqāt (Urdu) Hindustani Academy, Allahabad 1930

" ... 'Ilm al Jughrāfiya wal 'Arab, *al-Dia*, Azamgarh, Sept 1932, January 1933.

" ... Ziā Uddīn Humāyunī Aṣṭurlābī, *Ma'ārif*, Azamgarh, August, 1933.

" ... Arḍ al-Qur'ān (Urdu). 2 Vols.

" ... Arab Navigation, *Islamic Culture*, Hyderabad, Vol. XV, October 1941.

Nadvī, S.M. ... A Geographical History of the Qur'ān, Calcutta, 1936.

Newton, A P. (Editor) Travel and Travellers of the Middle Ages, London, 1926

O'Leary, De Lacy, D.D. How Greek Science was I assed to the Arabs, Kegan Paul Ltd., London, 1951.

Philby, H. St. Naqshah Bardārī Sharq-i-Waṣta (in Persian) Rozgār-i-Nau, Vol. IV, No. 4, B.B.C. London, 1945.

Raisz, E. ... General Cartography, McGraw-Hill, New York, 1938.

Reinaud, J.T. Introduction to General Geographie de Aboulfida, Paris 1848.

Sarton, G. ... Introduction to the History of Science, 4 Vols , Carnegie Institute of Washington, Baltimore, 1931, and reprinted 1950 53.

Schoy, C ... Geography of the Muslims of the Middle Ages, *American Geographical Review*, Vol. XIV, 1924

Sedillot, L ... L'Histoire des Arabes, Chap. IV, Paris, 1850.

Shiblī No'mānī Al-Māmūn (Urdu), Azamgarh, 1926.

Smith, D.E. History of Mathematics, Vol II (Ginn & Co.,) New York, 1925.

Taylor, E G R. Some Notes on the Early Ideas of the Form and Size of the Earth, *Geographical Journal*, Vol. LXXXV, January 1935.

Thorndike, L. A History of Magic & Experimental Science. 4 Vols , New York, 1923-24.

Yule, H. and Cordier, H. ... The Book of Ser Marco Polo (3rd Ed.) 2 Vols., John Murray, London, 1903.

Vincent, W. ... Commerce and Navigation of Ancients in the Indian Ocean, 2 Vols, London, 1807.

Youssouf Kamal, Prince ... Monumenta Cartographica, Africae et Aegypti, Leiden, 1935.

INDEX

ECONOMIC JUSTICE IN ISLAM

Dr. S. M. Yusuf

The book is mainly concerned with the concrete economic system of Islam. The religious faith is referred to only in so far as it motivates and characterises the system. In dealing with the concrete porblems of economic life, controversies around the accepted principles of Islam such as the prohibition of *ribā* are discarded. Attention is focussed on agricultural land tenure and the methods of industrialism, which violate the fundamental guarantees of Islam in regard to the free character of the gifts of Nature, the freedom of trade, the operation of the natural factors of supply and demand and the maintenance of the gold standard.

ECONOMIC SYSTEM UNDER UMAR THE GREAT

By Irfan Mahmud Ra'na

The book deals, as its title indicates, with the Islamic economic system prevalent during the Caliphate of Hazrat Umar.

The learned author has dealt with the subject under various heads, such as: Land tenure system, land reforms, trade at home and with other countries, sources of revenue, collection of taxes, public treasury, distribution of wealth, public works, etc.,

MUSLIM CONTRIBUTION TO SCIENCE AND CULTURE

By Mohammad Abdur Rahman Khan

The acquisition of knowledge in arts and sciences is essential for human progress. The history of acquisition of knowledge is also essential and a thrilling study. This small treatise gives the reader that thrill.

This short book unfolds before you the pioneer efforts of Muslim savants in the realm of science and culture. It proves what immense debt of gratitude the entire human race owes to the stupendous research labour of Muslim scholars in the domain of Arts and Sciences. It proves that what is popularly believe to be 'NEW' is really 'OLD'. The foundations of modern civi zation were laid by the eminent scholars of Muslim world. Tl book gives a brief account of the efforts of those scholars.